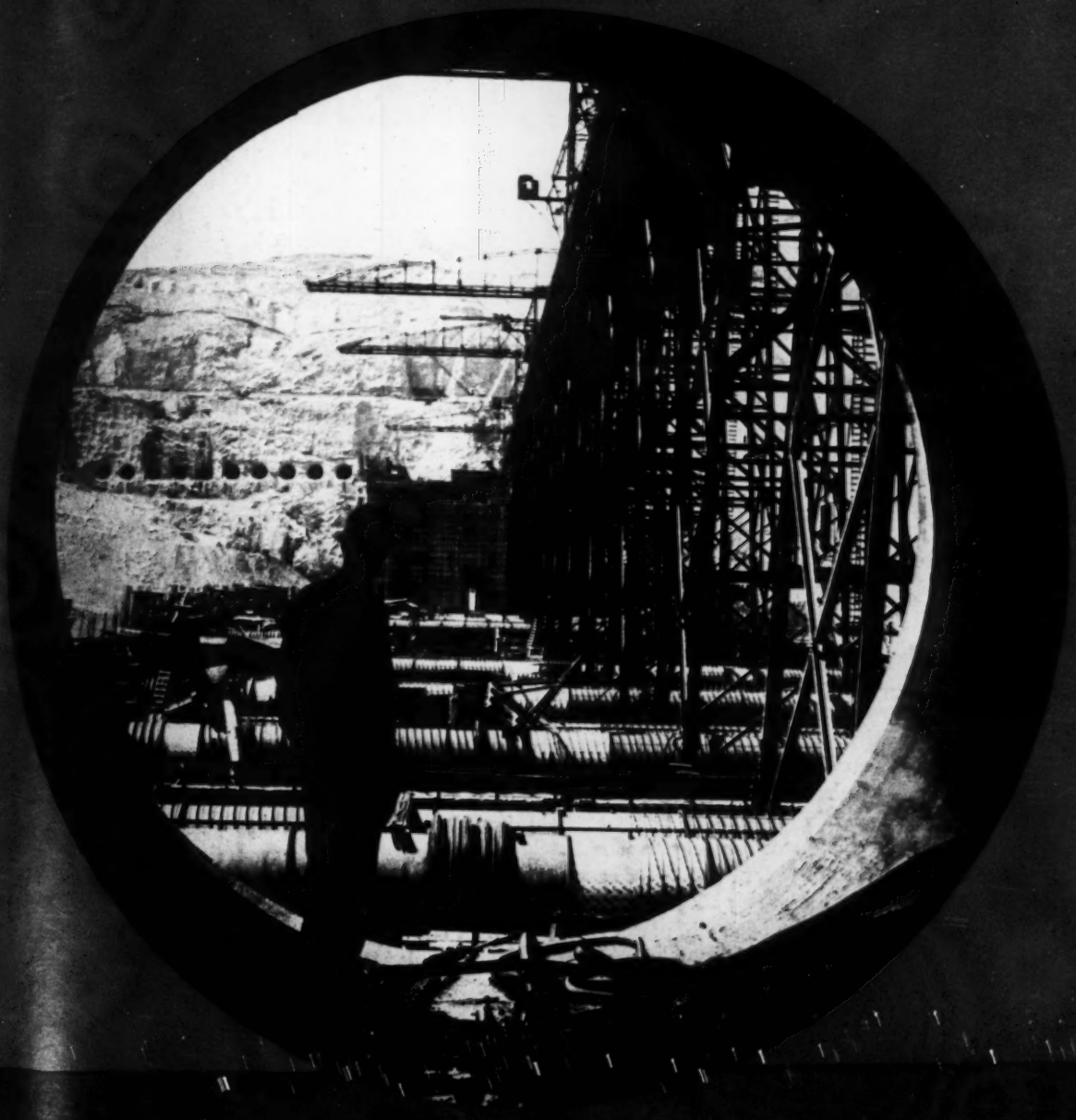
ENGINEERING CONSTRUCTION WEEKLY

ENGINEERING NEWS-RECORD

FEBRUARY 15, 1940



THE CONSTRUCTION YEAR IN REVIEW

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IN THIS ISSUE

● This issue is given over in large part to an appraisal of the year 1939 in its relation to the construction industry. It is not a post mortem. Rather, the editors attempt to evaluate the many happenings of the year as they affect future progress in the many fields of civil engineering that make up the industry.

Business conditions that have a special bearing on the construction industry are discussed in the pages that follow the news pages. This is supplemented by statements concerning special fields written by members of the editorial staff with the aid of many of our readers.

Of special importance are the statistics of construction because such an assembly and analysis of what took place last year gives the best available means for determining what the trends in volume and in cost are to be in 1940.

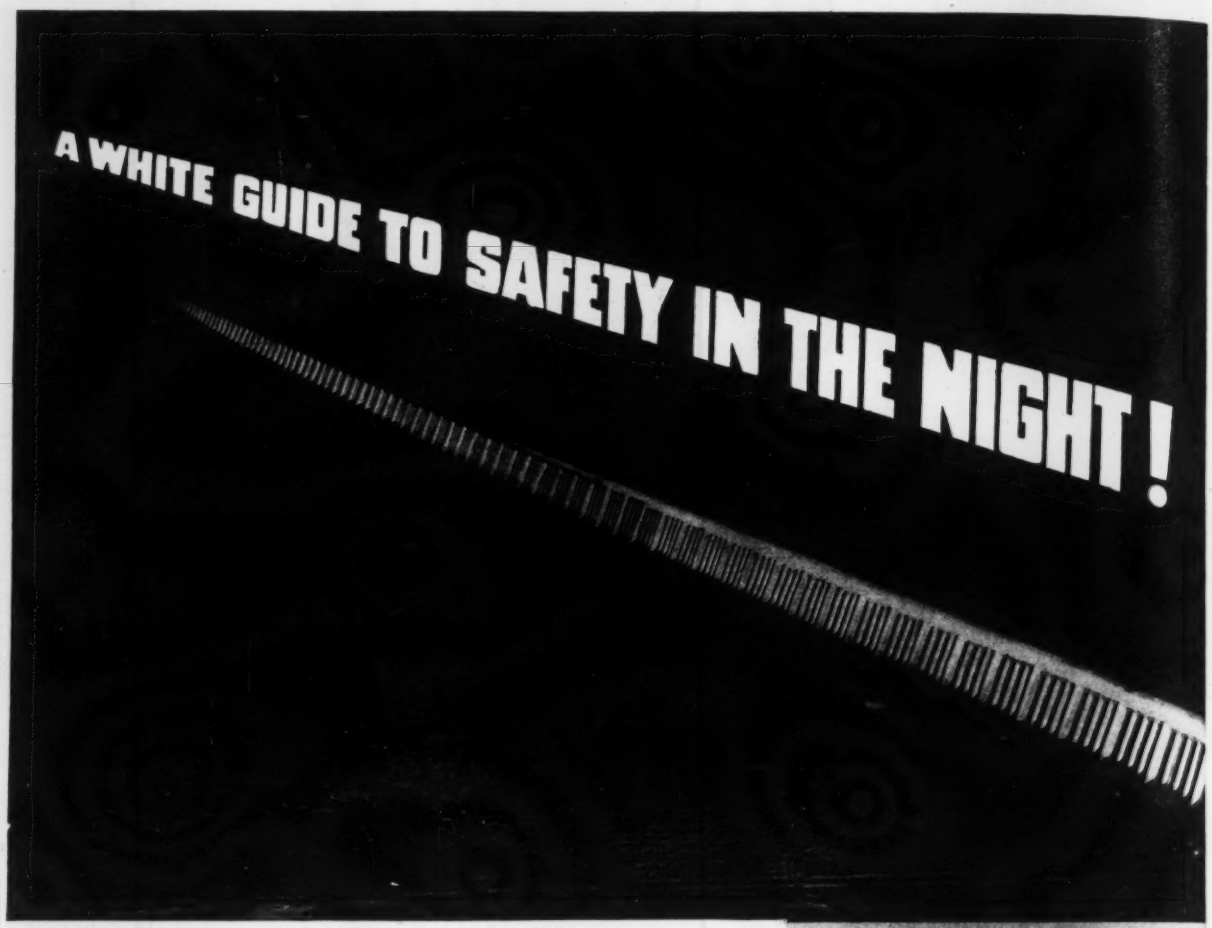
THINGS TO COME

STEEL PILES 194 ft. long were used on piers for a new bridge over the Potomac River at Ludlow Ferry, Md. This record pile driving job and other notable elements of the bridge piers will be described in an early issue.

THE PLANS of Los Angeles for spending $30,000,000 on sewage disposal and, ultimately, $250,000,000 on toll highways are to be given in the issue of Feb. 29.

SELECTION of motors for construction operations is to be the subject of the second article of a group on the application of electric power to construction.

MEDIAN STRIPS for divided highways will be discussed in the Feb. 29 issue.



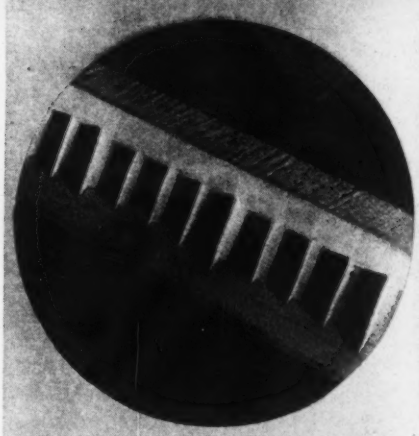
White Reflecting Curb — the new, permanent way to cut traffic accidents by day or night

ON the blackest night, a continuous white band of light will unfold in front of a speeding car on New Jersey Routes #24 and #29 near Phillipsburg when construction is completed this spring. Light from the headlights of a single car, used in taking this photograph, shows how well this curb guides traffic.

This is White Reflecting Curb, made with Atlas White cement and cast in place. Note the close-up view. The ribs or posts in shadow reflect light back to the driver's eye from a distance. Those in pure white reflect light near the speeding car. Result: A continuous band of reflected light. By day, too, in any weather, this curb increases visibility, and reduces driving strain, accidents and traffic congestion.

Many miles of White Reflecting Curb, both precast and cast-in-place, are installed today. Made with Atlas White cement, it stays white, needs no costly upkeep. It's permanent. It pays for itself in a surprisingly short time. Specify this economical white curb. Universal Atlas Cement Co. (United States Steel Corp. Subsidiary), Chrysler Bldg., New York.

NR-M-10



White Reflecting Curb made with Atlas White cement provides a broad, continuous band of light. Cast-in-place on New Jersey Routes No. 24 and No. 29 near Phillipsburg by Frapaul Construction Co., Inc., Hackensack, N. J.

ATLAS **WHITE** PORTLAND CEMENT FOR MARKERS AND CURBS

ENGINEERING NEWS-RECORD

NEWS

Volume 124 FEBRUARY 15, 1940 Number 7

New Toronto Water System To Be Idle Until 1941

As an economy measure, the city of Toronto will not commence operation of the city's new duplicate water supply system, now approaching completion at a cost of $15,000,000, until the year 1941, if then. An annual operating saving of $180,000 is seen, and it is claimed that the city is protected in any emergency since the plant can be kept ready for immediate use.

Construction of the plant, which includes a new deepwater intake in Lake Ontario, a large filter and pumping station at Victoria Park, a nine-mile tunnel connecting the new pumping station with an existing pumping installation, and a system of distribution mains, has extended over the last ten years. The capacity of the new pumping plant is 100 mgd.

• • •

Charges Against Builder Dropped in Pennsylvania

Charges, claiming that McCloskey & Co., contractors in Philadelphia, obtained pre-bid information from state employees, have been dropped by the Pennsylvania general state authority, after an investigation which failed to uncover any irregularities. The alleged "leaks" were associated with the Norristown State Hospital project. The investigation was started last year after Secretary Ickes charged that irregularities existed.

• • •

T. P. Clonts Made Manager Of Grand River Project

The Public Works Administration and the Grand River Dam Authority have selected T. P. Clonts as manager of the authority's project in Oklahoma. He was graduated from Texas A. and M. College in 1904 and is now serving his second appointment as city manager of Muskogee, Okla.

Denison Dam Suit Thrown Out by Court

Oklahoma lost the first major skirmish in its battle to stop the construction of Denison Dam, when the U. S. Supreme Court, on Feb. 12, denied its petition to file suit against Harry H. Woodring, Secretary of War, in that court. The court was equally divided on what appears to be a purely technical question bearing little relation to the basic question of whether the federal government, for the benefit of the citizens of one state, can take fertile lands in an adjoining state for a flood-control reservoir against the wishes of the latter state. The suit was brought by the attorney general of Oklahoma against Woodring as a citizen of Kansas, and not as the federal officer in charge of the flood-control work of the army engineers. The court refused to consider a petition brought in that manner.

Appropriation Bill Passed by Senate

Restores money for planning board and funds for Federal Works Agency

The Senate last week passed the independent offices appropriation bill, which had already been acted upon by the House. Chief change of engineering interest was the restoration to the bill of money for the National Resources Planning Board. The budget had allocated $1,060,000 for the agency, but the House cut this out on the grounds the NRPB had never been legally established. The Senate decided that the board could be considered authorized by the law setting up the now defunct Federal Employment Stabilization Board and so restored $710,000 to the board, but ordered the board to restrict

(Continued on p. 53)

Wide World Photo

WHERE TORNADO STRUCK LAST WEEK IN GEORGIA

SHOWN is a building in the business district of Albany, Ga., where a tornado struck on Feb. 10 causing damages estimated to exceed $5,000,000. Most of the buildings were of less substantial construction than this three-story brick structure. Deaths were 21 and more than 500 were injured.

A.G.C. Endorses Construction Probes; Plans Campaign Against WPA

Associated General Contractors in convention at Memphis also discuss labor relations, construction prospects and the outlook, legislation and other pertinent topics

The Associated General Contractors of America, meeting in its 21st annual convention at Memphis, Tenn., last week, endorsed the current governmental investigations of the construction industry, planned a vigorous campaign against the continued invasion of the industry by WPA, threw labor problems into the open for frank discussion and met labor leaders face to face, heard reports of the association's activities from the managing director and his staff, and listened to a lot of sound advice from several federal government officials. The convention was attended by some 600 contractors and chapter secretaries and managers from all parts of the country. Paul C. Gauger, general convention chairman, and the Memphis and Tennessee chapters, acting as hosts, were commended for their excellent handling of one of the largest meetings in the history of the A.G.C.

Endorse Arnold probe

By resolution the contractors "endorse a thorough official investigation into conditions affecting all phases of the construction industry, and urge that such steps be taken as may be necessary to correct any practices or conditions within or affecting the construction industry that are contrary to the public interest." The preamble to the resolution pointed out that the A.G.C. has always advocated and lent its support to the principle that only when the full beneficial use of the products of all the component parts of the construction industry are available to the public without restriction or penalty can the industry be sound. It was further stated that unsound practices and restrictions now exist, detrimental to the public interest, over which the general contractors have no control.

WPA condemned

The contractors were energetic in attacking their old enemy, the WPA, and closed with a strong resolution outlining a campaign to curtail WPA activities in construction. Many delegates reported that WPA had virtually taken over all public-works construction in their home areas, a situation all the more serious in the face of abandonment of PWA programs. The convention urged restoration of PWA, and also urged an extension of time for such projects now under way but impossible to complete by July 1, the original deadline. The resolution against WPA pointed out the waste and inefficiency of WPA work, the disruption of the construction industry and creation of unemployment in construction circles by WPA, commended Congress for the part restrictions placed on WPA last year, and demanded that Congress include the following points in the WPA program: "Require that information as to individual projects, including the estimated cost and the final cost, be made currently available to the public; prohibit the solicitation of construction projects for relief projects by WPA officials; limit the total cost on all types of WPA construction projects to a reasonable sum, this sum to be the total cost of the complete project ready for use by the public when completed and not a part of some larger project; and require the sponsor of each WPA construction project to contribute at least 50 per cent of the total cost, of which at least half represents cash outlay." The resolution further requested a substitution of worth-while public works built under the contract system for WPA, and that the needy be turned back to local governmental units for care, with the federal government contributing financial assistance if necessary. The president of the association was authorized to appoint a special committee to cooperate with the national staff to carry out the purposes of the resolution. Discussion of the resolution resulted in all of the chapter secretaries and managers agreeing to cooperate in a national drive against WPA.

Labor relations

In two and a half years, since the Atlantic City board meeting in October, 1937, the A.G.C. has made real progress in establishing labor relations as a major activity of the association. Last year at San Francisco the association was addressed for the first time by a labor leader, John Possehl. This year John P. Coyne, president of the Building and Construction Trades Department of the A.F.L., carried on the precedent set last year. His talk was friendly and earnest, pleading for continued cooperation between the A.F.L. and the A.G.C. He praised the association's labor committee, headed by E. P. Palmer, and managing director E. J. Harding and J. D. Marshall, labor secretary of the A.G.C., for their willingness to meet labor half way, to understand the problems of labor, which, he pointed out, were contractors' problems also, and for the cooperation that resulted last August in setting up means for ending jurisdictional disputes. Coyne stated that jurisdictional disputes were but one problem the department was working on; others include uniform daily hours of all trades on a job, maintaining of wage scales throughout the life of the job, and apprentice training, all in line with requests for attention made by the contractors at the San Francisco

AT THE A.G.C. CONVENTION IN MEMPHIS LAST WEEK

FRED SEXTON (upper left) president of the Memphis Chapter, A.G.C., host to the convention, and Paul A. Gauger, Memphis contractor, general convention chairman. Below are Edw. J. Harding, managing director of the association, H. B. (Pat) Zachry, Laredo, Tex., new president, and M. W. Watson, Topeka, Kans., new vice-president. Zachry and Watson are both highway contractors.

convention. The delegates were impressed by the sincerity of his remarks.

The question of labor relations popped up at every session. While no action of the association in regard to labor matters can bind any individual member without his consent, it is apparent that there is a growing tendency of contractors throughout the country to deal with organized labor. Roy A. MacGregor, of the Constructors Association of Western Pennsylvania, and Wm. Holland, of the Indiana Highway Contractors, explained in detail their satisfactory agreements with union labor. At all times, however, it was stressed that heavy and highway contractors must keep their labor relations apart from those of the building field, for conditions under which the two groups operate demand independent consideration.

Several federal officials presented papers, including Louis Johnson, Assistant Secretary of War, Brig.-Gen. Max P. Tyler, president of the Mississippi River Commission, W. P. Nelson, Bureau of Reclamation, H. K. Bishop, Public Roads Administration, W. E. Reynolds, Public Buildings Administration, and Wilburn Cartwright, House Roads Committee. All stressed the cordial relations existing between their departments and the contractors, outlined the prospects for work during the coming year.

Complete staff reports of the past year's activities were presented by Managing Director E. J. Harding, and division secretaries J. D. Marshall, Harry Kirk and W. A. Snow.

New officers

H. B. (Pat) Zachry, Laredo, Texas, was elected president for the coming year, and M. W. Watson, Topeka, Kans., was chosen vice-president. Chairmen and vice-chairmen of the three divisions were elected as follows: Heavy division, O. B. Coblentz, Baltimore, Md., and H. A. Dick, Portland, Ore.; highway division, F. W. Parrot, Sioux City, Ia., and Frank Nelch, Springfield, Ill.; building division, Dell E. Webb, Phoenix, Ariz., and M. J. Cummings, Boston, Mass.

The 1941 convention will be held at Houston, Tex.

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Appropriation Bill

(Continued from p. 51)

its functions to those of the old FESB. The effect of this restriction is not yet clear, but it is believed the federal works planning functions will not be seriously interfered with. There may be some restrictions on cooperation with state planning boards.

Whereas the House had eliminated administrative funds for the Federal Works Agency, directing it to get money from its component agencies, the Senate restored the $250,000, compensating in part for this by cutting $100,000 from the administrative funds of the agencies.

Both houses agreed on appropriating $20,250,000 for construction of public buildings, $4,970,000 under the budget. For federal-aid road payments, $100,000,000 is appropriated (of which the Senate would divert $10,000,000 to FWA).

Other appropriations approved by the Senate: for secondary roads, $15,000,000; for grade crossing elimination, $25,000,000; for public land roads, $1,000,000, and for the Pan American Highway, $75,000. For subsidy payments on USHA projects, $10,000,000 was appropriated.

The TVA appropriating remains at $40,000,000, although unsuccessful efforts were made in the Senate to cut the amount by $5,000,000 and to prevent construction of a dam at Coulter Shoals.

International Press Photo

INSTALLED AS PRESIDENT OF CANADIAN ENGINEERS

THOMAS H. HOGG, chairman and chief engineer of the Hydro-electric Power Commission of Ontario, Feb. 8, was installed as new president of the Engineering Institute of Canada at the Institute's annual meeting last week in Toronto. Following his graduation from the University of Toronto, Hogg worked for a time with the Ontario Power Co., Niagara Falls, Ont., leaving there in 1911 to serve as managing editor of the *Canadian Engineer*. He joined the hydro commission in 1912 as assistant hydraulic engineer.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

THE CORPS OF ENGINEERS is beginning a review of its "308" report on the Missouri River in South Dakota to determine whether power can be developed there to aid in the exploitation of deposits of manganese and other strategic materials. The review was ordered by the House rivers and harbors committee. It is an unusual assignment for the engineer corps since, although river reports always consider power possibilities, this is probably the first time the corps has been directed to look for power for a specific purpose. The manganese in question is concentrated in six townships in the central part of the state near Chamberlin and close to the river. A 1930 report of the Geologic Survey indicated the presence of about 102,000,000 tons of the metal—half the visible reserves in the United States. According to Representative Francis Case, sponsor of the project, power can probably be generated at a wide bend in the river nearby, where a cut-off would provide a 21 foot head in a distance of about a mile.

THE DEPARTMENT OF LABOR last week established minimum wages for the cement industry under the Walsh-Healey Public Contracts Bill. These wages must be paid by the manufacturers making cement for the Federal Government. The minimums range from 40 cents an hour in most of the southern states to 70 cents in the state of Washington.

NUMBER of locals chartered by CIO's Construction Workers Organizing Committee rose to 96 last week with the issuance of 16 new charters. Four of these were in the New York City area, three in California, and others in Indiana, Illinois, Colorado, Kentucky, Missouri, Iowa, and Maryland. Number of members in CWOC locals is restricted to 1,000; when a local gets larger it is split up. One local, in Los Angeles, has reached this maximum size. When more than one local exists in a city, as in New York and Los Angeles, a "Construction Workers District Conference" is organized and does the negotiating of contracts with employers.

CWOC is initiating a policy of having all labor agreements signed by the national organization. Thus when a contractor does work outside of his usual field of operations he will not have to make a new contract.

Engineers Consider Duties as Citizens

National and Ohio Professional Engineers Societies meet at Columbus Feb. 8-10

When more than 800 engineers, representing 23 states, met at Columbus, Ohio, Feb. 8-10 for the joint convention of the National Society of Professional Engineers and the Ohio Society of Professional Engineers, particular emphasis was laid on the importance of the professional rather than the technical work of the licensed professional engineer. The convention was the first occasion during which the national group had joined with any state society for such a meeting. It was the fifth annual convention of the national group and the 61st for the Ohio organization.

Public recognition

In discussing what is to be done if the engineering profession is to receive the public recognition that is accorded the medical and legal fields, E. A. Holbrook, dean of the school of engineering and mines at the University of Pittsburgh, appealed to the engineers "to stop being individuals" in their professional life and to "organize and work together." He asserted that all the average engineer asks is a good living and "the right to be left alone to work out technical matters." The greatest unsolved problem, he said "is to keep the mature middle-aged professional engineer an ordinary cooperative human being."

Charles E. MacQuigg, dean of the college of engineering, Ohio State University, warned engineers to recognize the transition in life because of the machine age. Labor displacement needs the immediate attention of the engineer, in his belief. He also advocated the injection of more humanistic and cultural subjects in the college curricula for the training of young men for the engineering profession.

"Present complexities of government and business have placed democracy under a great strain" which engineers can alleviate by becoming policy-determining members of their communities and ceasing to be merely technical specialists, was the view taken by Arthur E. Morgan, once president of Antioch College and former chairman of the Tennessee Valley Authority. "Before the engineer can be a substantial force in a democracy he must have a mind of his own, and he must have worked for and achieved a social philosophy which is not just a reflection of that of his last employer," Morgan asserted.

Discussing "Should the Engineer Ignore Civic Affairs," Arthur V. Sheridan, member of the City Planning Commission of New York City, stated, "In these days of organized opinion, and pressure application, the engineer cannot justify isolation. Society must prosper if he himself is to thrive. To accomplish this he most identify himself with the common activities and aims of his community, state and nation. Only by such means does he establish himself in the eyes of others. In a democracy, only by participation in civic affairs, not by decree, can the engineer hope to receive the social recognition to which he aspires."

That there is "no limit to development in this machine age" was a statement by J. Edward Trainer, general production manager of the Firestone Tire & Rubber Co.

Expansion of training

Robert C. Gowdy, dean of the school of engineering of the University of Cin-

A. L. Thompson Photo

ENGINEERS INSPECT TACOMA NARROWS BRIDGE PROJECT

HERE shown are engineers and officials of the Washington Toll Bridge Authority on a recent visit to the Tacoma Narrows Bridge and the Lake Washington pontoon span being built under their direction. From left to right the men are: P. H. Winston, secretary of the Washington Toll Bridge Authority; R. B. McMinn, member of the consulting board; L. E. Gregory, consulting board member; Clarence D. Martin, governor of the state of Washington; C. E. Andrews, principal consulting engineer; R. M. Murray, bridge engineer for the Lake Washington Bridge; R. H. Thompson, member of the consulting board; and Clark H. Eldridge, bridge engineer for the Tacoma Narrows Bridge. Engineers connected with the Tacoma Narrows Bridge but not shown are: L. V. Murrow, director of the state highway department and chief engineer for the bridge authority, and Theodore M. Kuss, chief engineer for the contractors —the work being done jointly by the Pacific Bridge Co., San Francisco, General Construction Co., Seattle, Wash., and Columbia Construction Co., Bonneville, Oregon.

The picture at the right shows a view

of the Tacoma Narrows Bridge from the east shore with the catwalks in place and cable spinning operations under way.

The $5,400,000 structure will be 5,560 ft. in length with a suspension span of 2800 ft.

cinnati, in speaking of the need for expansion of engineers' training, also emphasized that the study of humanitarian subjects must be amplified.

At the closing session of the national group, Robert S. Beightler, director of highways of Ohio, urged engineers to educate the public to a consciousness of the terrific cost of inadequate highways, and show that highway deaths cannot be stopped merely by legislation or law enforcement, but that safety must be built into highways.

New officers

The national society concluded its business by selecting Chicago for next year's annual convention and by electing officers for the ensuing year. John C. Reidel of Brooklyn, N. Y., was elected president to succeed Perry T. Ford of Columbus; J. W. Beretta of San Antonio, Tex., was chosen vice-president; and Leo Cleary, Washington, D. C., Samuel I. Sacks, Philadelphia, and Donald H. Walker, Indianapolis, were named vice presidents. Willard L. Simpson, Washington, D. C., was elected treasurer of the national group.

Harry E. Nold, Ohio State University, was chosen by the Ohio Society to succeed Carleton S. Finkbeiner of Toledo as president. Other new officers are: W. C. Kammerer, vice president and recording secretary; Fred J. Cellarius, Dayton, vice president; William S. Dun, corresponding secretary, and Cecil R. Leavens, Marion, treasurer.

Evanston Again Seeks A City Engineer

Evanston, Ill., a town of 70,000 population in the Chicago suburban area, has issued a call for applicants for the position of city engineer. Selection is to be on the basis of professional record and an examination of the applicant by a board of nationally known engineers. The position pays $4,500. This is an increase over the $3,000 offered last years for a position that should rate a salary of $6,000 according to representatives of the Western Society of Engineers, the American Society of Civil Engineers and the American Public Works Association who took the matter up with city officials at that time.

Minimum qualifications are: age 30-50, graduation in civil or municipal engineering from a recognized school and six years of experience in these fields of which five shall have embraced broad professional experience in engineering practice or public administration. Alternates include graduation in other branches of engineering supplemented by ten years' experience, of which eight shall have been in civil or municipal engineering or public administration, or any satisfactory equivalents in education or experience. The city engineer will have to supervise $300,000 of construction work in the 1940 program. Applications all must reach the civil service commission in Evanston, Ill., by March 2.

McLaughlin Air Service

QUEENSBRIDGE HOUSES THREE-FOURTHS OCCUPIED

ALMOST all tenants have been assigned and three-fourths have moved into Queensbridge Houses, New York City Housing Authority project, located in the Borough of Queens. At the bottom of the picture can be seen part of the Queensboro Bridge.

A community center building, a store building and 24 6-story dwelling units containing 3,144 apartments make up the development. Living accommodations for 11,400 are provided. The 47-acre site, twelve 200 x 600-ft. blocks, is 25 per cent covered by buildings. Construction will be completed about March 31.

A.W.W.A. Men Study Use of Watersheds

New Jersey section finds much conflict regarding recreational use of public water sheds

In an atmosphere permeated with "off the record" remarks the New Jersey section of the American Water Works Association listened to a round-table discussion concerning the use of watershed grounds for recreational areas, at a meeting held on Feb. 7. The lack of unanimity among the speakers, who represented health officers, municipal water authorities, planners, conservation and recreation interests, indicated that much in the way of compromise must be effected before a start can be made toward the enumeration of policies. The problem of multiple use of areas for water supply and recreational purposes is of concern throughout the country, it was said, and recommendations were made that the national association undertake a study of the matter.

State-wide regulations first

Comprehensive state-wide regulations designed to provide adequate health safeguards should first be promulgated before recreation centers are permitted on potable watersheds, was one of the suggestions made by W. C. Mallalieu, sanitary engineer of the Jersey City water department. C. T. Wilbur, director of the state department of conservation, pointed out that New Jersey was far behind some other states in its provisions for recreational areas and this deficiency might be overcome through dual use of present watersheds; from an economic point of view there was much justification for multiple use of these publicly owned areas, he concluded. Further support for this viewpoint came from Russell V. Black, consultant to the state planning board.

Picnic sites available

William Banks, division engineer of the Newark water department, explained that Newark now maintains three carefully supervised picnic sites on its watershed but does not advertise their availability. These sites, remote from any streams or reservoirs and provided with sanitary facilities, were set aside for public use following numerous complaints from taxpayers who claimed privileges on public land set aside for the watershed.

Other speakers in the symposium were: Warren Cowles, health officer, Hackensack Water Co.; Lloyd B. Sharp, executive director, Life Camps,

(*Continued on p. 57*)

OBITUARY

WILLIAM T. DEMING, 71, retired civil engineer of Seattle, Wash., died in that city Feb. 4. Deming had been located at Seattle since 1888. He was formerly employed in the city engineer's office at Seattle.

EUGENE H. ARNOLD, 91, who laid out the Nickle Plate R. R. system through northern Ohio and Indiana and the old Lake Shore Electric and Gates Mills interurban lines, died Jan. 31 at Rocky River, Ohio, where he had lived since retiring in 1930. Arnold also worked for a time with the Quincy & Western R. R., the Susquehanna & Western R. R., and the Chicago, Aurora & Elgin R. R. In 1910 he became city engineer of Rocky River, to hold that position for 20 years. He was also city engineer of Fairview, Ohio, for a time.

WALTER A. DOANE, 85, consulting engineer of Meadville, Pa., died Jan. 28 in Meadville. Doane started his engineering work in 1882, serving for three years as a bridge engineer for the Canadian Pacific Ry. in the Canadian Rockies. From 1890 to 1894 he served as principal assistant engineer on construction in Ohio for the Norfolk & Western R. R., and from 1895 to 1897 he was in charge of construction for the Carolina, Clinchfield & Ohio R. R.

Other recent deaths include: W. O. TRACY, 54, general western superintendent of the Norfolk & Western Ry. since 1936, Bluefield, W. Va. G. N. WOODS, 54, of Fort Scott, Kan., and WPA engineer in Topeka for the past two years, Pittsburg, Kan.; JAMES A. PATTON, 64, chief engineer of the Indian Territory Illuminating Oil Co., Tulsa, Okla.; JOHN DICKIE, 98, general contractor, Point LaNim, N. B.; ERSKINE M. SUNDERLAND, 67, engineer and architect of Laurel, Md.; WILLIAM M. KENYON, 76, retired Minneapolis architect and chief architect of the Minneapolis, St. Paul & Sault Ste. Marie Ry. for 20 years, La Jolla, Calif.; J. H. MAYER, general contractor at Humboldt, Ia., for more than 50 years; ANDREW J. KINGS, 84, pioneer builder of Mitchell, S. D.; HERMAN S. ANDERSON, prominent contractor of Alexandria, Minn., Steele, N. D.; FRANK W. LAWLOR, 83, superintendent of the Citizens' Water Co., Burlington, Ia., since 1903; THEODORE J. MOLZAHN, 71, president of the general contracting firm of J. Molzahn & Sons, Inc., La Crosse, Wis.; SAM SCHILLECI, former contractor, Ensley, Ala.; EUGENE GAGNON, 46, general contractor of Lambton, Que.; JULIUS M. PETERSEN, 69, senior member of the Petersen-Hiss Co., contractors of Sandusky, O.; J. M. MCFARLAND, federal government engineer on flood control work at Iola, Kan.; GORDON A. ELLIS, 33, civil engineer and assistant to the president of the Metal Brass & Copper Co. of Lisbon, Ohio, Clifton Springs, N. Y.; THOMAS E. MABRY, 82, builder for the El Paso & Southwestern R. R., Douglas, Ariz.; MICHAEL MILLER, 85, building contractor in Whitewater, Wis.; FRED J. CHAPMAN, 64, civil engineer with the Southern Pacific, Douglas, Ariz.; BENJAMIN W. SHOWALTER, 65, building contractor of Richmond, Va.; CHARLES H. SIMMONDS, 67, civil engineer for the Southern Pacific, Tucson, Ariz.

Ohio State Bridge Act Upheld by Court

The act creating the Ohio State Bridge Commission has been upheld in the Ohio common pleas court. In handing down its decision, the court severely criticized the taxpayer who started a suit that had cost the state at least $50,000 by delaying a refunding program, yet the taxpayer had little if any direct interest in the act. The delay was due to the fact that the bridge commission was restrained from issuing new bonds or buying more bridges until a ruling was issued.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the short week due to the Lincoln's Birthday holiday total $38,389,000, a decrease of 9 per cent from the volume for the corresponding week last year.

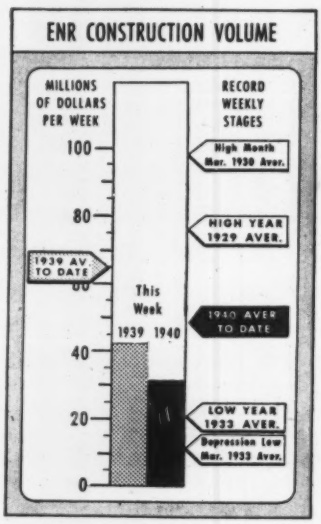
The week's total brings construction volume for the seven weeks of 1940 to $350,831,000, 23 per cent lower than for the 7-week period last year. Private construction, however, tops the 1939 total by 35 per cent.

Private awards for the week exceed the 1939 week by 5 per cent, but public construction falls 16 per cent below a year ago.

In the classified construction groups, bridges, industrial buildings, and streets and roads top their respective totals for the 1939 week. Bridges, and earthwork and drainage exceed the volumes reported for a week ago.

New capital for construction purposes for the week totals $28,630,000, an increase of 171 per cent over the volume reported for the corresponding 1939 week. The current week's new financing is made up of $15,587,000 in USHA loans for low-rent slum-clearance projects in 12 cities; $10,322,000 in corporate security issues; $2,221,000 in state and municipal bonds; and $500,000 in RFC loans for public improvements.

New construction financing for the year to date, $149,274,000, is 10 per cent higher than the $135,055,000 reported for the initial 7-week period last year.



CONTRACTS

(Thousands of dollars)

	Week Ending Feb. 16 1939	Feb. 8 1940	Feb. 15 1940
Federal	$5,635	$8,829	$6,407
State & Municipal	23,205	27,329	17,784
Total public	$28,840	$36,158	$24,189
Total private	13,570	21,365	14,200
TOTALS	$42,410	$57,523	$38,389
Cumulative 1940	(7 weeks)		$350,831
1939	(7 weeks)		$454,673

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial building, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1939 7 Wks.	Cumulative 1940 7 Wks.
NON-FEDERAL	$135,055	$149,274
Corp. securities	19,737	25,152
State & Mun.	99,687	62,775
R.E.A. loans	15,631	.....
U.S.H.A. loans	.....	60,786
R.F.C. loans	.....	561
FEDERAL	$.....	$.....
TOTAL CAPITAL	$135,055	$149,274

FHA MORTGAGES

	Week Ending Feb. 11 1939	Feb. 3 1940	Feb. 10 1940
Selected for appraisal	$21,709	$15,981	$19,439*
Cumulative 1940	(6 weeks)		$96,539*
1939	(6 weeks)		$109,786

* Subject to revision.

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Feb., '40	238.32	114.56
Building Cost	Feb., '40	201.50	108.93
Volume	Jan., '40	173	76

Use of Watersheds

(Continued from p. 55)

Inc.; H. P. Croft, chief engineer, state department of health; H. T. Critchlow, state water policy commission; M. Gibbons, supervising chemist, Rahway water department.

The morning session of the meeting was devoted to an inspection trip of the Johns-Manville plant in Manville, N. J., where the manufacture and shop testing of asbestos-cement pipe was demonstrated. About 140 members and guests of the association attended the meeting.

• • •

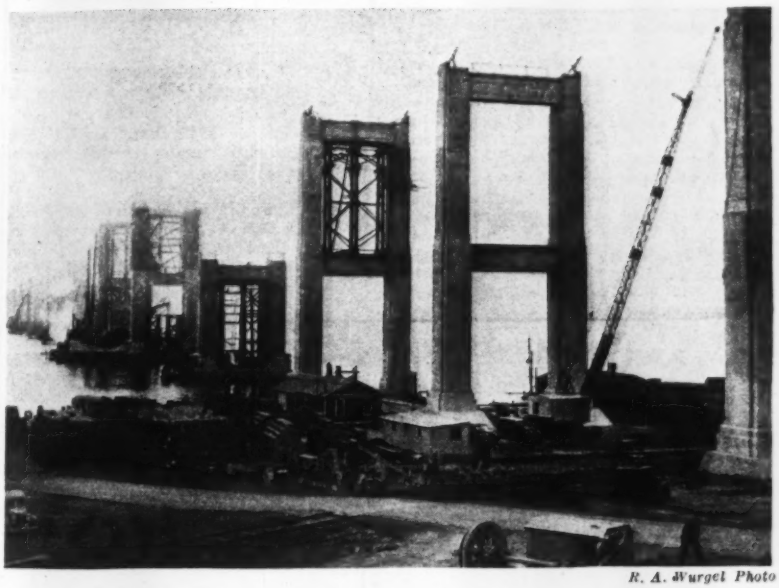
Philadelphia Water System Rehabilitation Urged

Prompt rehabilitation of Philadelphia's waterworks system to eliminate hazards resulting from under maintenance in past years is among the recommendations made in a recent report by the Better Philadelphia Committee on Water Supply, a civic group. Although the water supplied to the public is generally safe from a bacteriological standpoint, the committee explained, it is not always satisfactory as to tastes, odors and appearance.

Rates for water service are very low, but substantial contributions from these revenues have been made to the general funds of the city, it was pointed out. It was also urged that a financial policy be adopted to assure sufficient funds annually for the adequate maintenance of the system.

The report stated that the city has an ample supply from the highly polluted Schuylkill and Delaware rivers, but this supply should be improved by treatment of sewage discharges.

Members of the committee making the report were: Charles Haydock, consulting engineer; William C. Beyer, director of the Philadelphia Bureau of Municipal Research; R. H. Lansburgh, Pennsylvania Economy League.



R. A. Wurgel Photo

GETTING RARITAN RIVER PIERS READY FOR LONG GIRDERS

With all ten of the pneumatic caissons for the foundations completed and the piers for the north and south approaches nearing completion, work on the new high-level highway bridge across the Raritan River above Perth Amboy, N. J., is well advanced. The structure, to cost about $4,670,000, is being built for the state of New Jersey under the supervision of the New Jersey State Highway Department, of which James Logan is state highway engineer and Morris Goodkind is bridge engineer. The 4,388-ft. structure will consist of 29 plate girder spans of which eight are 200 ft. and one 250 ft. They provide a 135-ft. clearance. Two 24-ft. roadways separated by a 4-ft. island and two sidewalks are accommodated on the deck.

The work is scheduled for completion by June. A PWA grant of $2,113,000 is aiding in financing the undertaking.

Steel erection has been started by the Bethlehem Steel Co., Bethlehem, Pa., which holds the contract for the superstructure work. Substructure work is being done by P. F. Connelly, Long Island City, N. Y.; work on the south approach by Fehlhaber Pile Co., New York City; and the north approach is being built by J. F. Chapman & Son, Hillside, N. J.

Roads in South Damaged by Cold

Weather causes from $2,000,000 to $2,500,000 damage in Georgia; loss great in other states

The unusually severe weather of January has caused heavy damage to highways in the South, including from $2,000,000 to $2,500,000 to the roads of Georgia, according to the results of a survey of conditions in Georgia, Tennessee, North Carolina, Virginia, South Carolina, and Alabama, made by *Engineering News-Record*.

In telling of the unusual maintenance costs expected in Georgia, W. B. Brantley, state highway engineer, stated, "All types of construction have been affected by this freeze, particularly surface treated roads with limerock and chert bases as well as a large amount of concrete."

Damage great in North Carolina

"It will be impossible for us to determine the damage to our road system as a result of the recent weather for some time," stated W. Vance Baise, highway engineer of North Carolina, "but I roughly estimate that the damage will approximate $2,000,000."

J. W. Gentry, state highway engineer of Tennessee, reports that "At this time we are unable to give you an accurate estimate of the damage. However, it has been considerable and it is expected that the rains which are following the cold weather will accentuate this condition."

Virginia damage small

In describing conditions in his state, C. S. Mullen, chief engineer of the Virginia department of highways, stated, "From the standpoint of cost of snow removal . . . we estimate the increase over regular maintenance cost to be $100,000. On our low type roads we have at present load restrictions of 5 tons on 1,500 miles. Should 10 per cent of the 1,500 miles have a complete failure we estimate it will cost approximately $500,000 to replace them. This should be the limit of our losses."

"From the information I have at hand, I believe that $200,000 would be a liberal estimate of the damages to roads on the state highway system, including the cost of removing snow from the highways," was the report of J. S. Williamson, state highway engineer of South Carolina.

"It is our opinion damage will not exceed $150,000 with the probability of its running less," Chris. J. Sherlock, director of the Alabama State Highway Department, reported.

Engineering News Events of 1939

IN ORDER to give a quick summary of the outstanding engineering events of 1939 the following chronological summary has been prepared. Additional information about each event may be obtained by consulting the issue of *ENR* corresponding to the italic number in parenthesis.

JANUARY

FIRST INTAKE of Colorado River Aqueduct placed in service Jan. 7, water being delivered by the intake pumping plant to the Gene Basin Reservoir. *(Jan. 5)*

CONTRACTS awarded for main span of the Lake Washington pontoon bridge at Seattle. *(Jan. 5)*

SECRETARY OF WAR Jan. 5 approves installation of penstocks for possible future power development of New England flood control projects. *(Jan. 12)*

TVA's Guntersville Dam completed Jan. 16 six weeks ahead of schedule. *(Jan. 19)*

FEDERAL FLOOD CONTROL in Vermont attacked by Governor Aiken because state consent was not obtained before starting work. *(Jan. 19)*

DELAY OF DENISON DAM construction asked by Oklahoma to allow investigation by state engineers. *(Jan. 26)*

FEBRUARY

UTILITY COMPANIES Jan. 30 fail to obtain injunction to halt TVA work; U. S. Supreme Court refuses to review the case. *(Feb. 2)*

EARTHQUAKE in Chile kills 30,000. *(Feb. 2)*

BATTERY BRIDGE proposed for New York City. *(Feb. 2)*

PENNSYLVANIA added to list of states opposing federal flood control. *(Feb. 9)*

DEPARTMENT OF JUSTICE asks U. S. Supreme Court to reconsider the traditional "fair value" as basis for public utility rates. *(Feb. 16)*

CIO recognized on Metropolitan Life housing project in New York City; FAECT being approved as bargaining agent for draftsmen. *(Feb. 16)*

MARCH

U. S. ENGINEERS recommend canal to join Ohio River with Lake Erie. *(March 2)*

CONTRACTOR'S license law proposed in Texas and Ohio. *(March 2)*

ILLINOIS SUPREME COURT upholds State Housing Act. *(March 2)*

LAW REQUIRING Arkansas contractors to be licensed passed by State legislature. *(March 9)*

PRESIDENT ROOSEVELT urges immediate construction of third set of locks for Panama Canal. *(March 16)*

HIGH POINT, N. C., hydro-electric development project receives 50-year license from Federal Power Commission. *(March 16)*

LOWER COLORADO RIVER AUTHORITY announces plans to increase height of Marshall Ford Dam, additional storage to be for flood control. *(March 23)*

WEST VIRGINIA ratifies Ohio Valley stream pollution act. *(March 23)*

AERONAUTICS AUTHORITY appeals for federal aid on airport construction. *(March 30)*

U. S. SUPREME COURT rules that states and nation may tax each other's employees. *(March 30)*

NORTHWESTERN UNIVERSITY receives a gift of $6,735,000 for an Institute of Technology. *(March 30)*

LAW REQUIRING all Idaho engineers to have license passed. *(March 30)*

APRIL

POLICIES and practices of TVA upheld by a joint Congressional Committee formed last year after Arthur E. Morgan, former chairman, charged dishonest and inefficient procedure. *(April 6)*

FLOOD carries away bridge in Mississippi on Vicksburg-Jackson Highway; 15 people die. *(April 6)*

RIGHT of High Point, N. C., to build a $6,000,000 hydro-electric plant on Yadkin River challenged. *(April 20)*

REORGANIZATION PLAN to consolidate all regular and emergency public works bodies in the Federal Works Agency sent to Congress by President. *(April 27)*

INVESTIGATING BOARD recommends reconstruction of Fort Peck Dam; slide of Sept. 22 attributed to foundation failure. *(April 27)*

AIR BASE PROGRAM calling for construction of 15 navy projects in three years at a cost of $66,800,000 gets approval. *(April 29)*

BUREAU OF PUBLIC ROADS reports to Congress that a country-wide grid of superhighways could not be financed by tolls. *(May 4)*

MAY

BRONX-WHITESTONE BRIDGE completed three months ahead of schedule. *(May 4)*

U. S. ENGINEERS approve $28,000,000 Clark Hill power and flood control project in Georgia on Savannah River. *(May 4)*

CONGRESS allots $63,000,000 for reclamation work, largest such allotment ever made. *(May 11)*

LAST CONCRETE poured for Bartlett Dam on Verde River in Arizona, highest multiple-arch dam in the world. *(May 18)*

MILWAUKEE'S new $5,060,000 filtration plant goes into service *(May 18)*

NEW PLANS for Battery Bridge at New York disapproved by Army Engineers. *(May 25)*

JUNE

GOVERNOR OF MARYLAND May 11 signs bills authorizing a plane coordinate system for cadastral surveys. *(June 1)*

PLACEMENT of last concrete for lining of San Jacinto Tunnel completes concrete work on the 38 tunnels totaling 108 miles for the Colorado River Aqueduct. *(June 8)*

BY PLACING 20,684 cu.yd. of concrete in 24 hours at Grand Coulee, the Consolidated Builders, Inc., break record established by M.W.A.K., contractors for the low dam. *(June 8)*

A $11,260,000 CONTRACT awarded June 10 to the Permanente Co., Simla, Calif., for supplying 5,800,000 bbl. of low-heat portland cement for Shasta Dam. *(June 15)*

MASSACHUSETTS AND NEW HAMPSHIRE consent to acquisition of land by federal government for flood control work. *(June 22)*

CONSTRUCTION ASSOCIATION of Western Pennsylvania signs closed shop agreement with four labor unions after 30 months of negotiating. *(June 22)*

FEDERAL WORKS AGENCY set up to take over Bureau of Public Roads, Reclamation Bureau, U. S. Housing Authority and the Public Buildings Branch of the Treasury Department. *(June 29)*

TOLL COLLECTION begins June 21 on Merritt Parkway in Connecticut. *(June 29)*

JULY

WPA construction over nation slowed up by strikes of organized labor against regulation requiring all relief labor to work thirty hours per month for security wage. *(July 13)*

BREAK OCCURS in $75,000,000 Albert Canal in Belgium killing seven; canal to have been dedicated soon by Belgian King. *(July 13)*

YADKIN RIVER not navigable, North Carolina Supreme Court rules in High Point case. *(July 20)*

HIGHLAND PARK BRIDGE over Allegheny River at Pittsburgh dedicated. *(July 27)*

MASON & HANGER Co., New York, low bidder on Lackawack (Merriman) Dam of New York's Delaware water supply system with bid of $15,486,000. *(July 27)*

BIDS REJECTED July 22 for Continental Divide Tunnel, Colorado-Big Thompson reclamation work. *(July 27)*

AUGUST

HOUSE kills lending-spending bill to provide loans for road and public works projects. *(Aug. 3)*

CIO announces plans to invade construction field. *(Aug. 3)*

BILL AUTHORIZING TVA to issue bonds for acquisition of Commonwealth and Southern properties signed by President. *(Aug. 3)*

TERZAGHI holds settlement of New Orleans hospital inevitable. *(Aug. 10)*

ADDITIONAL set of locks to cost $277,000,000 authorized for Panama Canal by Congress. *(Aug. 10)*

BUILDING AND CONSTRUCTION trades department of AFL and AGC end jurisdictional disputes by agreements signed in Atlantic City; all men returned to work on jobs shut down because of labor troubles. *(Aug. 17)*

HEALY SUBWAY CONSTRUCTION Co., bidding $6,436,000, bids low for Dearborn St. subway in Chicago. *(Aug. 17)*

G. F. ATKINSON Co., San Francisco, with a bid of $5,344,000, on Aug. 21 low bidder for Stevens Dam, formerly Mud Mountain Dam. *(Aug. 24)*

COLLECTION OF a 10-c. toll per vehicle begins Aug. 20 on Hutchinson River Parkway in Westchester County, N. Y. *(Aug. 24)*

FHA MAKES borrowing easier with 15-year loans and by not requiring borrower to own building site. *(Aug. 31)*

TEN-MILLION-DOLLAR express highway connecting Brooklyn and Queens boroughs in New York City opened Aug. 23 with dedication of Meeker Ave. Bridge. *(Aug. 31)*

NEBRASKA HOUSING LAW held constitutional by a state district court. *(Aug. 31)*

WAR THREAT causes cancellation of International Engineering Congress scheduled for New York Sept. 5-8. *(Aug. 31)*

SEPTEMBER

POLLUTED WATER seen as cause of typhoid epidemic at Illinois state hospital at Manteno; eight deaths and 200 cases of sickness reported. *(Sept. 7)*

WOODEN FALSEWORK being used in constructing 866-ft. concrete arch span, in Sweden, longest such span ever attempted, fails killing 18 construction workers and demolishing structure. *(Sept. 7 and Sept. 28)*

FIRST of 25 pontoons goes into place for $8,000,000 Lake Washington Bridge at Seattle. *(Sept. 14)*

BUFFALO'S sewage treatment works costing $15,000,000 officially placed in service. *(Sept. 14)*

CARMODY returns 5,000 applications for proposed PWA projects totaling $1,700,000,000; no funds available. *(Sept. 14)*

COMBINATION BID by Griffith Co. and Bent Co. low for Friant Dam work, $8,715,000 being bid for construction of this unit of the California Central Valley Project. *(Sept. 21)*

WAGE UNCERTAINTIES delay federal work; Bacon-Davis Act—"prevailing rates" law—studied by Department of Interior. *(Sept. 28)*

MASSACHUSETTS passes law requiring naming of subcontractors on jobs over $5,000. *(Sept. 28)*

OCTOBER

FAILURE of Bureau of Reclamation to obtain satisfactory bids on Continental Divide tunnel attributed to war situation. *(Oct. 5)*

UNION PAVING Co., San Francisco, low bidder for construction of piers and abutmets of Pit River Bridge. *(Oct. 12)*

SECRETARY WOODRING ordered by U. S. Supreme Court to show why injunction halting Denison Dam work should not be granted. *(Oct. 12)*

NORTH BEACH AIRPORT, built at a cost of $40,000,000, dedicated Oct. 15 at New York. *(Oct. 19)*

WORK RESUMED on central railroad terminal in Montreal following abandonment in 1933. *(Oct. 19)*

CLEVELAND Oct. 6 opens Main Ave. Bridge, most important highway artery completed in the U. S. this year. *(Oct. 19)*

BELT CONVEYOR SYSTEM 49,000 ft. long proposed for bringing materials to Shasta Dam. *(Oct. 19)*

NATION-WIDE investigation by Department of Justice of building industry gets underway in Cleveland and Pittsburgh. *(Oct. 26)*

MISSISSIPPI reaches all-time low at Greenville, Miss. *(Oct. 26)*

NOVEMBER

USHA, by setting up short-term financing machinery, sees 2 per cent interest saving in public housing construction. *(Nov. 2)*

BELT CONVEYOR SYSTEM for bringing construction materials to Shasta Dam site approved. *(Nov. 2)*

BANKING FIRMS submit no bids for Niagara Falls Bridge and RFC shows no interest in $3,800,000 in bonds. *(Nov. 2)*

LARGE RFC loan assures completion of Possum Kingdom Dam, Reclamation project in Texas. *(Nov. 2)*

LAST RIVET driven Nov. 1 for $100,000,000 Rockefeller Center development in New York City. *(Nov. 9)*

THE FIVE-YEAR JOB of placing 122,000,000 cu.yd. of hydraulic fill at Fort Peck completed. *(Nov. 16)*

HOLING THROUGH of Queens Midtown Tunnel celebrated Nov. 8 at New York. *(Nov. 16)*

CHICAGO'S 400-mgd Southwest Sewage Treatment Plant Nov. 6 officially opened. *(Nov. 16)*

HIGHWAY BRIDGE over Rio Grande between Hidalgo, Texas and Reynosa, Mex., fails. *(Nov. 23)*

U. S. COURT OF APPEALS rules that Appalachian Power Co. does not need federal license to operate power plant in Virginia on New River. *(Nov. 23)*

CALIFORNIA AQUEDUCT put into service. Nov. 9 with flow of Colorado River water into Cajalco Reservoir. *(Nov. 23)*

CIO's Construction Workers' Organizing Committee signs first labor agreement with an organization of employers. *(Nov. 30)*

FIRST SECTION of Delaware Aqueduct holed throught Nov. 22 for New York City's new water supply. *(Nov. 30)*

DECEMBER

HYDRAULIC FILL work completed for Sardis Dam. *(Dec. 7)*

CONTINUED DEPLETION of New York City's water supply reservoirs causes concern. *(Dec. 14)*

NEW TOLL HIGHWAY BRIDGE across Missouri River at Brownville, Neb. dedicated. *(Dec. 14)*

PASSENGER AUTOMOBILE and other tolls reduced on San Francisco-Oakland Bay Bridge. *(Dec. 28)*

A REVIEW OF NATURAL HAPPENINGS shows that 1939 lacked sensation. No major floods occurred and only one oustanding "cloudburst" flood, when 9 in. of rain fell in 4 hrs. at the headwaters of the Licking and Kentucky Rivers. The Weather Bureau estimates total flood damege for the year at only $11,000,000. Storms, tornadoes and earthquakes also were average in number and tornado deaths low—97 against normal 265. Rainfall east of the Mississippi was about normal, from 88 per cent in New York and Pennsylvania to 104 per cent in Kentucky; in the West, well below normal—under 70 per cent in Wyoming, Colorado, Nebraska and California. An unusually wet winter everywhere and a wet spring and summer in the East were followed by the dryest fall on record, seriously depleting many water supplies. In the West, the fall drought, following a dry spring and summer, was severe, and fall rains in Nebraska and Kansas were less than 30 per cent of normal. Streamflow and groundwater were low in the late dry months, but new low records were set only in Oklahoma. The country over, fall flows ranged from 30 to 80 per cent of normal.

Buttresses of Possum Kingdom Dam, a flat-slab and buttress type structure 190 ft. high for flood-control and power on the Brazos River in Texas.

Civil Engineering and Construction in 1939

An Editorial Review

By Way of Introduction

ONCE A YEAR a reviewing of progress, a stock-taking of attainments, even a reveling in achievement is good for the soul and of benefit to mind and morale. And since such a review is essentially a marshalling of newly acquired knowledge it provides a necessary ingredient for further advance. In this spirit and with this objective, the editors, with the counsel and help of many readers, have compiled this review of progress in 1939. These first few pages emphasize those happenings and trends in business, government, labor relations, and professional affairs, that made the year distinctive so far as engineers and construction men are concerned. To this roster of events, that willy-nilly affect life and livelihood, are added reviews of the specialist fields of activity in which engineering judgment and construction sense and ingenuity are permitted free rein; the result is a record of sound achievement. But there is more—the statistical picture of the industry and a 16-page illustrated summary of the status of over one hundred of the major construction projects, notable for their size or significance. In the facts and figures presented is much to marvel at, much to be proud of and much to ponder over.

Nature Favorable, Business Good

NATURAL CONDITIONS were generally favorable during 1939. Few major storms, floods or earthquakes troubled mankind, and except for a moderate drought that covered much of the United States, Nature appeared to do what she could to bring prosperity. In business and industry the year lived up to its advance billing. All signs pointed to improvement over 1938, and few lines of business activity fell short of prediction. When the long-feared European war flamed into actuality in September it tended to black out all that had happened before, but after a flurry of excitement it was evident that the eventual appraisal of 1939 would still rest largely on developments domestic in character. On the other hand war business or its possibility accounted for a stepping up of activity in the last quarter. Employment was up, relief rolls down somewhat. Electric power consumption marked new high levels. The pattern of the business year is pointed by the *Business Week* index, which, starting at 105, declined gradually to around 90 early in May and then, as gradually, rose to 108 until it encountered war in September; followed a sharp rise to 125 at the end of the year. Inventories were high but not dangerously so as in 1937.

Construction Accompanied Business

THIS HIGH BUSINESS and industrial tempo was reflected in construction activity, which registered an 8 per cent gain over 1938. Except for 1937, private contract awards exceeded any year since 1931. In this direction lies normalcy. But public awards were the highest on record, exceeding 1938 by 6 per cent and reflecting new high amounts for state and municipal and a slight falling off in federal work. Largest gain was in industrial buildings, 86 per cent, while residential building ran a close second. Commercial building, a shadow of its former self since 1930, dropped below the modest plateau it had reached in 1938. In public works new all-time records were made in roads, sewage disposal, waterworks and public buildings. Bridges, in their second highest year, were 12 per cent above 1938. The construction total adds up to nearly 7 billions, a very respectable amount.

Recovery and Unemployment

IN THE RECOVERY from the 1938 setback, industry reabsorbed many of its former workers during 1939, but not enough to make an appreciable cut in the list of unemployed, still estimated at about 10,000,000. As measured by employment, recovery could hardly be said to have reached an advanced stage, a condition reflected also in the construction ratio, which in contrast with activity in manufacturing industry remained one-third below normal. A promising sign appeared early in the year, however, in vigorous re-

sumption of factory construction, which accelerated during the last quarter to a rate equaling the intense activity of 1937, itself but little below the peak of 1929. Coupled with this was steady progress in housebuilding, one of our largest industries in normal times; for the first time in nine years a total of half a million units was approached.

Prices and Construction Costs

STABLE PRICE LEVELS, neither unduly high nor unduly low, furthered business progress by forestalling harmful speculative movements. Wage levels in the construction field as well as in general industry also changed little, and construction costs remained at levels fair to both buyer and seller. The most significant price element of the year was the sustained low level of the investment market. Only municipal bonds were in high demand, while all forms of private investment remained inactive.

Twilight of PWA

MAJOR FACTOR in the public works picture was the Public Works Administration, whose organization hit high gear for the first time in getting contracts under way with speed and efficiency. Before the year was half gone, however, it was evident that the economy axe was going to fall on its efforts to get additional Congressional appropriations. President Roosevelt's desperate effort to save it by a plan to eliminate the 45 per cent grant in favor of a 100 per cent federal loan for self-liquidating projects (the famous spend-lend program) was quickly defeated. As available money ran out, employee personnel was cut, putting many engineers on the unemployment list. Attempts to save the PWA principle if not its payrolls through a skeleton organization in the Federal Works Agency, to which government reorganization transferred it, were given a good chance of success. It was one of the ironies of fate that the PWA was not able to operate as the efficient pump-priming agency which was envisioned at its inception until just before it was marked for the discard. In its six years of existence it had helped finance nearly 35,000 projects, half federal and half local, costing 6 billion dollars. All of this helped recovery, but only the last 8,000 contracts hit the bullseye at the psychological moment.

WPA Continues

WHILE PWA was being allowed to dry up, WPA was having its troubles too. In response to widespread dissatisfaction with WPA politics and work-relief policies Congress did a thorough job of remodeling and wing clipping. The prevailing wage was eliminated, making every relief worker put in 130 hr. per month. Building projects exceeding $50,000 in cost were prohibited for WPA work. After 18 months of service relief workers were taken from the rolls to make way for others on the waiting list. These were widely regarded as healthy and constructive reforms. Economy also hit the WPA appropriation, which was cut a third to less than 2 billions for the 1940 fiscal year.

Public Housing

ANOTHER federal construction activity that had to take in sail during the year was public housing. Operating under a three year authorization to lend and pay subsidies to the amount of $800,000,000 the USHA sought a like amount for continuing its activities, but was turned down. With the money it had, however, USHA made good progress. A total of 145 projects, providing 58,000 living units, are under construction at an average cost per unit of $2,831; land and other expenses bring the unit cost to $4,867. Not all public housing was federally financed, New York City providing its local housing authority with funds derived by a tax on rented business properties, to be used to service housing authority bonds. On broader scale New York State by legislative act provided for issuing 50 millions in bonds, and 100 million more later, to be loaned to municipalities for housing on the USHA model. Public housing, from 1939 signs, is here to stay.

For the National Defense

DESPITE these economy moves, however, the public debt was to be allowed no breathing spell in its climb toward the statutory limit of 45 billions. National defense needs, a subject which has been simmering for over a year, was brought to a boil by the imminence of European war, and Congress came through with huge army, navy and air corps appropriations. Included were substantial public works items—air bases, harbor works, barracks and $277,000,000 for a third set of locks for the Panama Canal.

Ample Development Funds

CONGRESS also was lavish in providing funds for certain major kinds of national development works. Flood control, newest national undertaking, proceeded on the basis of the fundamental acts of

1936 and 1938 at an expenditure of $90,000,000. Reclamation, formerly a 10-million-dollar-a-year activity, spent $80,000,000. Extension of the TVA development operations also proceeded under full supply of funds.

Government Policies

THE RELATION of the engineer and the construction man to his national government thus was subjected to a profound change in 1939. But if the work that he got as a result of federal activities showed signs of diminishing, he was still to be affected to a great degree by federal policy. For one thing, law enforcement by administrative bodies, typified by the National Labor Relations Board, continued to be troublesome. A different type of law enforcement was the anti-monopoly investigation of the Department of Justice, which brought its guns to bear on the building industry in an effort to clean out rackets and unfair competition and thus reduce costs. Labor leaders, contractors and manufacturers serving this field were indicted in 11 different cities. During the year repeated clashes with the federal policy of condemning land for flood control reservoirs occurred; states rights were held to be violated, and in New England and Pennsylvania particularly dam work was held up pending settlements. TVA policy also continued to be unknown and unexpressed.

Public Works Reorganized

OF LESS IMMEDIATE EFFECT on construction but of possibly great long-time importance was the establishment of the Federal Works Agency, the germ of a public works department in the federal government. Presidential order grouped in this new agency the former Bureau of Public Roads—renamed Public Roads Administration—the PWA, WPA, U. S. Housing Administration, and the Public Buildings Administration, former branch of the Treasury's Procurement Division. The Works Agency also has the duty of carrying on design and construction work for other government bureaus that may request such assistance. Such development would make the FWA a close rival of the Army Engineers in its influence on construction.

The Power Picture Changes

POWER was not as prominently in the limelight of government interest as during the preceding five years. No important moves were made toward extension of federal ownership of power sources. TVA and Grand Coulee construction went on at full pace. TVA bought some additional private generating plants and distribution lines, and Bonneville obtained some contracts for early disposal of a substantial block of power. Work in installing or planning for power equipment at various federal flood-control and navigation dams also went forward, but in general the government's aggressive attitude of competition with private power producers was greatly tempered.

Industry Questions

BY NO MEANS did all problems and relationships of the year center on federal action. Idaho adopted an engineer's license law, bringing the number of states having such laws to 42. License laws for contractors were passed in four states, bringing the total to nineteen. The CIO in midsummer began an active campaign to organize the construction industry, heretofore the almost exclusive field of the AFL, but little accomplishment was recorded. Some progress was made in the matter of better salaries for engineers, the American Society of Civil Engineers having given its approval to a schedule of classification and pay for four grades of engineers.

What of 1940?

THE EVENTS reviewed above and in articles beginning on the next page are important. But while looking backward is a common human trait that has its uses, planning is always for the future. What of 1940? Predicting what volume the coming year may bring is even more precarious than usual, what with war on the foreign scene and an election pending on the domestic front. But weighing all factors as realistically as possible, a decline of about 2 per cent from 1939 levels is indicated. Principal reason, of course, is the tightening of federal purse strings. Despite an indicated gain of 6 per cent in road and bridge construction, public works will drop off considerably. Substantial improvement in private construction—war or no war—should offset much of the public construction loss, without however producing a net gain for the year. Taking at full value the nation's present mood to avoid war, the new year can be regarded as a transition period from depression to normalcy in construction. Such a period is one of steady rather than spectacular adjustment. Under such circumstances the fact that we may expect to approximate 1939's reasonably high construction tempo is cause for satisfaction.

Sanitary Engineering

EDWARD J. CLEARY

TOPPING ALL PREVIOUS YEARS in dollar volume of new construction, the 1939 record of progress in water supply, sewage treatment and refuse disposal is one of special accomplishment. And since the work of the sanitary engineer has been marked by innovation as well as by volume, the object of this review is to summarize some of the more significant developments and trends of the past year.

Taking a backsight first at accomplishments in the field of water supply: New construction reported by *Engineering News-Record* totaled $163,000,000, a substantial gain over the $131,000,000 spent in 1938 which then was an all-time record. To what good purpose this money goes is revealed in the nation-wide inventory of water supply facilities made by this journal in cooperation with state sanitary engineers, which showed that two-thirds of the total urban population in the United States is now served by community systems. Highlights of the inventory were these: There are 12,750 waterworks, of which 73 per cent are publicly owned; about 9,150 employ groundwater compared with some 3,300 which draw their supplies from streams and lake sources; 85 per cent of 81,200,000 people served by water systems receive water that has been given treatment for health protection, quality improvement or both.

Progress in major supply projects was signalized by important events on opposite sides of the country. On Jan. 7 the first water flowed in part of the Colorado River Aqueduct, the 240-mile system which was started in 1932 to bring a billion gallons of water daily to the coastal plain of southern California. In the East, where work was pushed on the Delaware Aqueduct to increase New York City's supply by nearly 50 per cent, the first tunnel connection was holed through on Nov. 22. Almost half of the excavation on the 85-mile tunnel is completed.

Boston and Baltimore advanced their aqueduct and tunnel work to the point where construction was nearing completion, and Chicago finally began work on its long-delayed filter plant. (Details on these are given in the major projects section of this issue).

Water storage developments

Characterized by distinctiveness were four elevated steel water tank installations. At Lake, Wis., a million-gallon tank 152 ft. above the ground was designed so that a town hall and municipal offices could be incorporated in the supporting steel framework; an octagonal concrete shell incloses the frame and half of the tank, thus satisfying esthetic considerations. Dual purpose water storage structures of this kind are common in the Netherlands (*ENR*, Dec. 1, 1938, p. 709), but their use in this country and elsewhere is unusual.

Something new in water storage facilities made its appearance in Brookline, Mass., where a spheroidal tank (of the type previously used only for gasoline and oil storage) was built. The tank stores 1.65 mg of which 1,000,000 gal. are available within the narrow head range of 25 ft. At Batavia, N. Y., a 1.5-mg tank elevated to a height of 169 ft. was completed, which ranks first in order of total height of any structure of equal or greater capacity, and second in water tower height. The new 1.5-mg storage tank in Indianapolis is distinguished by the use of multiple riser pipes and the substitution of tubular column supports for struc-

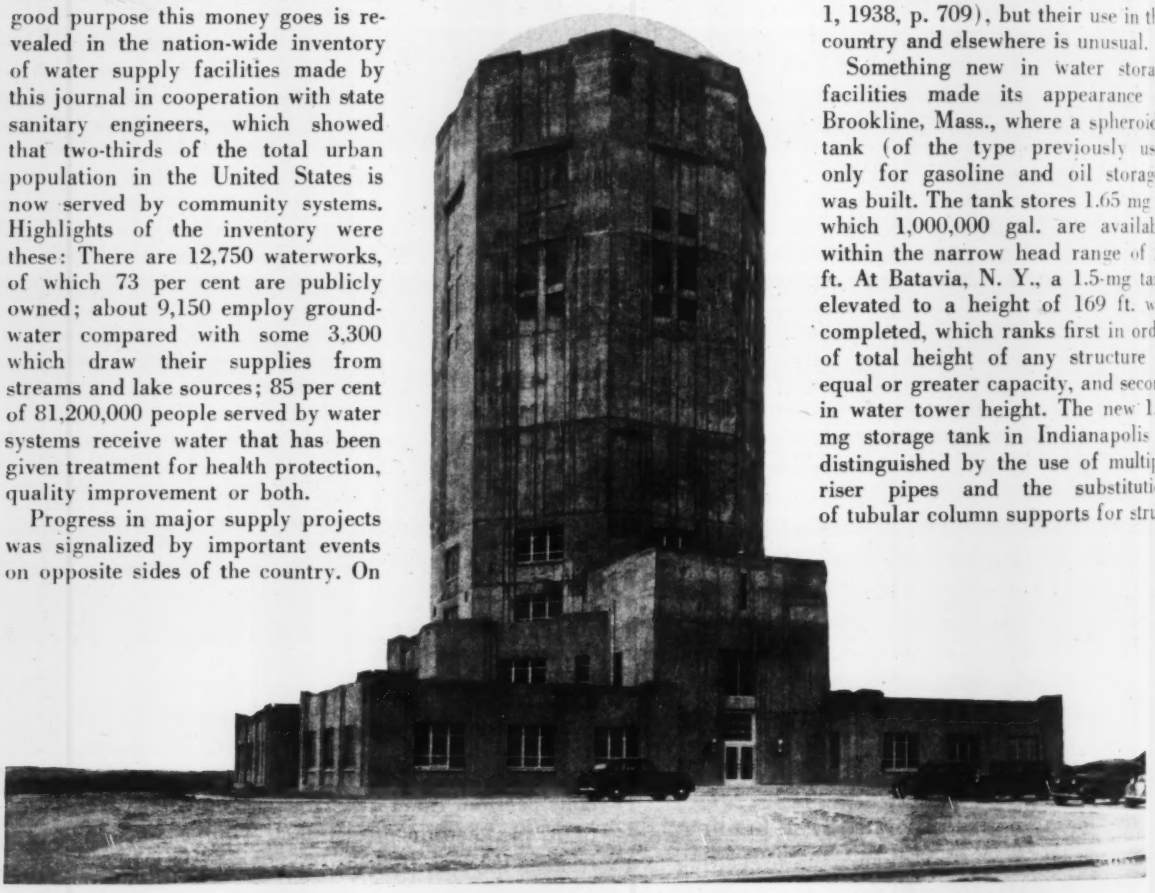


Fig. 1. Novelty and beauty in water storage facilities are illustrated by this combination municipal building and water tank structure nearing completion in the town of Lake, Wis.

tural shapes; each of the 16 tower members consists of a steel cylinder, 54 in. in diameter.

Cathodic protection for corrosion control is not a new idea, but its successful application for the preservation of steel water tanks was demonstrated this year in reports from Dayton, Ohio, and several other cities showing that rusting and corrosion could be eliminated by such means. Protection was secured simply by suspending a metal rod in the tank to which was connected the positive terminal of a low-voltage source of direct current. The tank itself was connected with the negative terminal. Current passing from the anode through the water serves to plate the tank sides with hydrogen ions and thus forms a protective film.

Water treatment advances

Ozonation, superchlorination and sodium hexametaphosphate treatment took the spotlight in the field of water purification improvement. Development of new equipment for the generation of ozone and for its diffusion in water, places new emphasis on the use of this gas for sterilization, as well as for taste and odor control. Heretofore, high operating costs were a principal factor in discouraging ozone treatment. But greater economies are promised with the new equipment; in one case the cost of ozone treatment for a water from a badly polluted source was reported to be only $2.80 per mg based on electric energy cost of 2c. per kwh. Two installations are now being made—one at Whiting, Ind., to handle 4 mgd, and the other at Denver, Pa., to treat 400,000 gallons a day.

The superchlorination process (application of such large doses of chlorine as to require subsequent use of a dechlorinating agent) was demonstrated to be an effective means of taste and odor control at a number of treatment plants. The dosages—ranging from 1.0 to 7 ppm—were said not to be excessive in cost when compared with other methods of control.

A new means for inhibiting corrosion and preventing calcium carbonate scale formation in distribution systems using sodium hexametaphosphate received wide attention. Surprisingly small concentrations of this chemical (2 ppm or even less in some cases) added to hard or partly softened water is said to prevent precipitation of calcium carbonate.

Dorr Co. Photo

Fig. 2. One of the new combination clarifier and flocculator tanks installed at the Bakersfield, Calif., sewage disposal plant. The mechanical preflocculation process is reported greatly to improve sedimentation efficiency.

Biggest news of the year in the softening field was the announcement of the Metropolitan Water District of Southern California that a 100-mgd lime-zeolite softening plant would be built to reduce the hardness of Colorado River water from 300 to 125 ppm. Construction is now under way.

Distribution practice

Among the developments in water distribution materials and practices, the following were significant: (1) announcement of a new law of design for cast iron pipe (emphasizing importance of external loading) based on 13 years of study by a committee of the American Standards Association; (2) initial use of a new type of flexible but watertight joint on a submarine water main at Bath, Maine, where a deep, irregular channel and steep river banks called for special precautions; (3) the Los Angeles study of water hammer phenomenon in long pipelines, the findings of which should result in important modification of valve design and operation; (4) studies on the service life of cast iron pipe mains which indicates that 8-in. pipe has an average life of 150 to 170 years, while that for larger pipe is even more; (5) the record-breaking pipe-laying job at Little Rock, Ark., where 9,400 ft. of 6-in. asbestos-cement water main was installed and ready for service in nine days; (6) the introduction of a rubber caulking material as a substitute for hemp or jute in cast iron pipe joints, and (7) the availability of a radio signal device called the "pipe anticipator," that can be easily attached to an excavating machine and which will warn the operator of buried pipe and cable.

One incident marred the fine record of technical achievement in water supply practice—the Manteno, Ill., state hospital typhoid epidemic—although the engineering profession cannot be held responsible. The death of 52 patients and the total of 394 cases of typhoid contacted from a polluted well supply resulted in malfeasance indictments against hospital officials who were charged with having ignored state health department reports that the water was unsafe.

Sewage disposal progress

Construction of sewage disposal facilities, like those for water supply, set a new volume record of $150,000,000, and thus exceeded the previous $136,000,000 all-time record of 1938. An inventory of disposal facilities published by this journal at the beginning of the year showed that more than half of the urban population of the United States is served by some 4,700 treatment plants—a number which has been substantially increased through the tremendous activity in sanitation during the past year.

If further stimulus is needed to point to the necessity for treatment plant installations, then the new information concerning the possibility of infantile paralysis being spread by sewage-contaminated water should be effective. That the dreaded epidemic infection may be transmitted through sewage was suggested by the work of the department of medicine at Yale University, where, for the first time, the presence of poliomye-

litis virus in sewage was demonstrated following a study of the Charleston, S. C., outbreak last summer. Other investigators in Louisiana and Massachusetts produced evidence indicating that pollution may play a role in poliomyelitis epidemics.

Process improvements

Outstanding among the practical contributions to process improvements were "potential chlorination" and "mechanical preflocculation," both of which reflected the vitalizing influence of equipment manufacturers in the economics of sewage treatment. Potential chlorination equipment developed by the Wallace & Tiernan Co. makes it possible automatically to feed chlorine in accordance with changes both in flow volume and sewage strength in such a way that a predetermined residual can be maintained. Use of this system eliminates the wasteful possibility of chlorine overdosing as well as the hazard of underdosing.

Engineers of The Dorr Co., announced a low-cost method of increasing disposal plant efficiency simply by stirring sewage prior to sedimentation. Results from laboratory and plant scale trials were reported which showed that as much as 23 per cent increase in clarification efficiency was obtainable when raw sewage was first agitated with a paddle wheel mechanism for a 30-40-min. period. Offering a challenge to chemical treatment, this new system of mechanical preflocculation has already been installed in some 20 disposal plants.

A novel method of clarifying the effluent from a centrifugal sludge dewatering machine by means of quiescent flotation was given a public demonstration by the American Centrifugal Corp. during the year. Centrifuge effluent containing as much as 3 per cent solids content is clarified by an upside-down sedimentation process to produce a final effluent reported to contain less than ½ per cent solids. The process is entirely mechanical.

The biofiltration process of sewage treatment developed by Harry N. Jenks, consulting engineer of California (details of which were first reported in *ENR*, May 21, 1936) came forward for renewed attention when two major companies announced the availability of engineered equipment for the process. The term "biofiltration" designates the principle of repeatedly passing sewage at high rates of application, through a small volume of rock filter medium; this method of treatment combining basic characteristics of the trickling filter and the activated-sludge processes, is said to cost about 30 per cent less than a standard trickling filter installation.

Biggest research job of the year is that currently under way by the U. S. Public Health service which started a stream pollution survey of the Ohio River. Covering a drainage area of 204,000 sq.mi., the survey of the 1,000-mile-long Ohio and its tributaries will take three years to complete. From the findings obtained in this study of river conditions correlated with domestic and industrial waste discharges, recommendations will be made concerning remedial measures for pollution abatement.

The novelty of the year in disposal plant structures was the elliptical concrete domes built to cover 150-ft.-diameter trickling filters at Hibbing, Minn. Ingenuity in the design—which was complicated by openings in the top and bottom of the domes—resulted in a structure whose shell was only 3½ to 6 in. thick; the economy of this construction was reflected in the cost of 75c. per square foot of covered area.

Federal legislation for stream pollution abatement, which has run a stormy course in the Congress since 1936, once again was put in limbo as it neared the point of passage into law. The Barkley bill (providing for U. S. Public Health Service jurisdiction in cooperation with state authorities) was passed by the Senate on May 1, but was not acted on by the House. It is up for early attention in this session of Congress, but proponents of a bill which would put control in the hands of the Corps of Engineers are ready for a hard fight.

Refuse disposal developments

In the field of refuse disposal perhaps the most significant development is the activity on the West Coast where incineration experiments with rotary kiln type furnaces have quietly been under way. Sacramento, Calif., experimented with a small rotary kiln using garbage which had a moisture content of about 85 per cent. Results were encouraging enough to warrant the city's planning for more exhaustive tests. Los Angeles made tests on a kiln-type furnace for destroying rubbish; it was believed that with the addition of fuel in a burner at the lower end, similar methods and equipment could be used for garbage destruction. Near Oakland, Calif., there is a large plant with a kiln-type furnace which has been operated only experimentally thus far by a private scavenger organization.

New York City, last year's storm center on the controversial question of refuse disposal by land fill, effectively continued this method of disposition and thus handled some 8,000,000 cu.yd. of refuse. The park department of the city, apparently realizing the value of such fill practice in expediting its program for the extension of recreational facilities, arranged to have a large marshy area covered by land fill methods. Meantime a board of experts appointed by the U. S. Surgeon General started an investigation to determine whether New York fills were "a menace to public health and safety." The board was appointed in accordance with an arbitration agreement between attorneys for the city and Queens County, which led to the dismissal of county grand jury indictments previously handed down against city officials.

The rich opportunities for research in land fill practice were recognized when New York University started a program in March, aided with WPA allotment of $134,000 sponsored by the New York Department of Sanitation. Basic data on biological and physical factors involved in refuse decomposition are being gathered.

Incineration continued its forward strides with some 16 plants under construction and 11 new installations proposed. The largest of the new jobs is the 600-ton installation at Pittsburgh costing about $900,000; the largest proposed plant is that for Atlanta, Ga., where a half-million-dollar installation will replace an existing incinerator which has enjoyed a profitable by-product business in steam sold for heating buildings.

In summary, it can be said that progress this past year in water supply and sanitation practice was marked by numerous as well as ingenious refinements rather than by spectacular revolutions in method. The record would thus indicate that we have emerged from an era of sometimes uncertain but necessary experimentation into a period of accelerated, practical accomplishment.

Municipal Progress

W. W. DeBerard

BETTER PROGRAMMING of public improvements, closer study of the blight problem, a start on superhighways to and through congested areas, a better appreciation of the relation between lighting and accident incidence, increased control over traffic, and lower financial costs are factors in the municipal field that indicate an unusual awareness of new and old urban problems by the technical and administrative agencies running our cities.

Long range programming of municipal improvements received a boost through the demonstration studies carried out in seven typical cities by the public works committee of the National Resources Planning Board. The cities are Winchester, Mass., Kalamazoo, Mich., Nashville, Tenn., Dallas, Tex., Fargo, N. D., Spokane, Wash., and Sacramento, Calif. In each case a six-year program was worked out with the idea of setting down those projects considered desirable in relation to their necessity and financial feasibility. It is contemplated that each year a new six-year program will be worked out. The greatest advantage is the gearing of financial ability to the acquisition of desired public improvements. The committee specifically states that comprehensive planning should precede such a budgeting procedure but that such programming can be done regardless of planning.

Blight problems

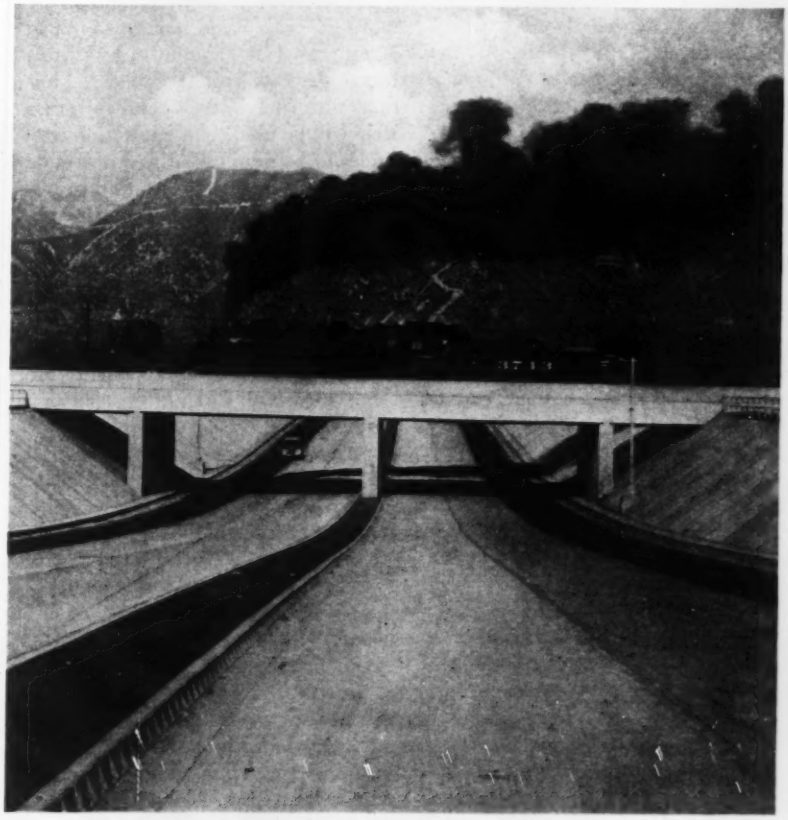
What to do with blighted areas in large cities still remains the No. 1 unsolved municipal problem. Most slum clearance advocates feel that better transportation through superhighways, long advocated in many quarters, is after all only a minor item. Re-zoning based on a land use survey, a bit of horse-sense judgment and the use of better recreation facilities will have far more effect. Legislation in Illinois to permit segregation of property by corporations through condemnation failed of pass age but is still considered one of the large legal aids towards rehabilitation. The construction of federal-built houses goes merrily on but it hardly makes a dent in the great mass of sub-standard houses occupying over-priced land.

Demolition continues. How many more buildings are coming down in such places as the Chicago Loop, where more than 20 per cent have been razed to give way to parking spaces and "taxpayers", is beginning to worry those who are trying to maintain values. American cities are not static, and all will be well if rebuilding follows razing—but does it?

This brings us to decentralization which many real estate leaders feel has already run its course and will soon operate in reverse, with many of those who rushed to the rim of our cities to escape taxation and other burdens now turning inward to enjoy once more the advantages of accessibility and nearness to the center of gravity of their customer population.

City entry roads

In city planning one of the outstanding events was the impetus given by the report of the Public Roads Administration recommending that city entrances rather than cross-country toll roads be established. Detroit and a few other cities are working on definite plans in case Congressional action makes federal



Safety built into a city highway at East Pasadena, Calif. Here we have a wide underpass lighted with sodium vapor lamps, a subdivided trafficway with reflector curbs on the center strip, pedestrian walkways, and paved side slopes.

money available for this purpose.

Continued increase in automobile registrations with attendant increase in congestion and accident incidence has led municipal engineers to look with favor on relief through widening existing streets and building new ones of the superhighway or limited-way type. Grade separation work throughout the country has continued active, due chiefly to federal and state aid. The work done in cities generally is not in the luxury class, as is the case with some rural separations. Chicago, with separations well established at one-mile section lines, is now hard at work on those at the ½-mile intervals. New York, having got the New York Central tracks off the streets of Manhattan has begun a $37,000,000 program to free the streets of Brooklyn and Queens of Long Island R. R. crossings.

Streets and paving

Resurfacing of paving continues at a high rate since it is ideally adapted for work-relief projects. A much more lenient attitude is evident on the part of state and county officials toward extension of rural highways into urban congested areas where poor pavement exists due to the cessation of special assessment financing. The tax-paying lot owner has fairly well sloughed off this tax burden although he still reaps the benefits of living on well-paved streets and thoroughfares.

Pavement construction and maintenance practice have not materially changed during the year. A continued high percentage of paving is done by the aid of relief agencies. In many states the nearly defunct special assessment procedure of financing is used to raise the sponsor's share of work-relief projects.

In street cleaning the year saw the advent of the small street sweeper with its high degree of maneuverability. Its rapid adoption is attributed more to low cost than to any other factor. In a field so inarticulate as street cleaning, publication of a book by the American Public Works Association describing current street-cleaning practice and evaluating it is worthy of note.

Planning of city-service and supply yards has been given consideration especially as to function and accessibility. Units for storage, servicing, administration and labor are logical ones to care for first. New Haven, Conn., has done some constructive thinking on this neglected phase of municipal public works housekeeping.

Notable in administration setup is the change made in New York City whereby new construction and operation on buildings, bridges and sewage disposal is now centralized in a city-wide department of public works after being in separate borough offices for many years. This still leaves in separate departments, the activities of sanitation, parks, docks and water supply agencies.

Better traffic control

Traffic control, a comparatively new field of engineering, is progressing rapidly and maintaining a high standard of personnel. More and more cities are turning to trained traffic engineers to take over work now being handled by police departments with minor assistance from the overworked staffs of the city engineer. Dallas and Detroit are recent examples. Extension of progressive systems of traffic lights continues, with closer adjustment to the traffic load. Lane lining of pavements is far more general. Wide boulevard traffic is separated by a multitude of different devices with the general view that ultimately curbs and a grass strip will be used. Channelization continues to be a useful adjunct to safety at difficult intersections. Parking is still a major municipal problem that in a few places has been handled by the city and financed on the revenue bond basis. For those who want to park but a brief time Salt Lake, Atlantic City and a few other cities have penny parking meters which are quite successful in limiting parking abuses.

Since 65 per cent or more of fatal accidents in large cities occur to pedestrians, it is worth notice that a report just off the press from the street and highway traffic section of the National Safety Council sums up the situation with excellent recommendations.

On signals, the only new feature of the year are the several experiments with neon lights being made in Boston and Chicago. There is definite interest in the possibilities of eliminating glare. At the Road Show a committee of the American Road Builders Association put on an exhibit to measure visibility as seen by the driver. Detroit has a test using mercury vapor lights and is studying the possibility of using fluorescent lights.

Sodium vapor lights are being tried for underpasses in cities, always a difficult lighting problem. Better street lighting, following the experimental work in the East to eliminate glare, has not made the progress hoped for. Accident frequency at poorly lighted points still continues high and much lighting education remains to be done, despite the laudable efforts of many private utility companies.

Municipal money

Due to the war, the cost of municipal money has tightened and the stabilization at 2 per cent expected last summer probably will not be realized. A figure ½ to 1 per cent higher now seems more likely of attainment. Credit reserves are so large that some authorities contend that the absorption by the expected increase in business activity will not be sufficient to affect prime municipal bonds.

On the other hand municipal resources are low due to the numerous economy restrictions that have been laid down by state legislators to constitutional limitations, to charters and to John Q. Public when he is asked to vote for a bond issue. Economy-minded elements of the average city have taken such advantage of relief agencies that there has been little or no extension of credit resource. This has forced forward all kinds of so-called self-liquidation paper, more euphoniously called revenue bonds, as against the former practice of issuing faith-and-credit paper.

Glancing ahead

Municipal administrators may confidently look forward to no less serious problems than have confronted them during the past year. Money will be cheap but the passage of the day of grants and the softness engendered thereby as well as the inefficiencies which have crept in due to work relief are real hurdles ahead for those who propose to give more service per dollar expended. The year past has produced its share of items looking toward better urban living and the personnel of our cities generally can look forward to even better results this year.

Flood-Control Progress

V. T. BOUGHTON

THE YEAR 1939 was an active one in flood control, the most active one in projects inaugurated and money spent since flood control became a live national issue following the disastrous floods of 1936. But in broad planning for flood control as an element of national planning for the conservation and use of our water resources no progress was made. National planning for water use, as envisioned by President Roosevelt when he set up the National Resources Committee as an agency to direct and integrate the long-range planning of the several federal departments concerned with water, passed off the stage as a practical operation leaving the active planning for most flood control and navigation in the hands of the Corps of Engineers, the planning for irrigation supplies and related flood control in the hands of the Bureau of Reclamation, and other less clearly formulated planning to the Federal Power Commission, Department of Agriculture and the Public Health Service. Those agencies are cooperating in the planning of all flood-control work authorized by Congress.

National planning for coordinated development and use of this country's water resources may be said to have begun in 1925 when the River and Harbor Act of that year instructed the Corps of Engineers and the Federal Power Commission to report to Congress on the cost of surveys of the navigable streams of the United States and their tributaries upon which power development appears to be feasible and practicable, with a view to "formulation of general plans for the most effective improvement of such streams for the purposes of navigation, and the prosecution of such improvements in combination with the most efficient development of potential power, the control of floods and the need of irrigation." Those instructions ultimately resulted in the preparation of a series of reports by the Corps of Engineers relating to all our major rivers, currently known as 308 Reports from the act of 1927 that authorized them. The 308 Reports still are a source of basic information for flood-control planning.

A second start on water use planning was made in the early '30s, when the President, through the National Resources Committee, inaugurated a broad study of water resources as the basis for a great continuing program of public work that could be used to reduce unemployment. That study may be said to have reached its climax in the 1937 revision of "Drainage Basin Problems and Programs," a report prepared by the water resources committee of the National Resources Committee with the aid of 45 drainage basin committees and containing a six-year program of flood control, navigation, pollution abatement, power, irrigation, domestic water supply, soil and wildlife conservation, and beach erosion control. However, while this report was comprehensive in the variety of subjects covered it lacked definiteness as to how the projected work was to be carried out.

Meanwhile the floods of spring of 1936 brought the passage of the first

Arkport Dam, on the Canisteo River, a tributary of the Susquehanna. It is typical of the headwater reservoirs being built on many rivers to hold back flood waters for the protection of communities farther downstream.

MAJOR FLOOD CONTROL PROJECTS UNDER WAY IN THE UNITED STATES

This map, based on one prepared by the Corps of Engineers, U. S. Army, indicates the location of the major reservoirs, channel improvements and levees being built under the flood control acts of 1936 and 1938. Included are combined navigation and flood control projects such as those of the Tennessee Valley Authority and work on the lower Mississippi River begun under other acts of Congress; also flood-control projects built by local agencies.

national flood-control act, an act that authorized the expenditure of $310,000,000 on a large number of projects scattered across the country. It places flood control and allied work under the jurisdiction of the Secretary of War and the checking of soil erosion in the Department of Agriculture. The two federal departments were authorized to spend $5,000,000 each on surveys. But the whole act was made largely ineffective by the failure of Congress to appropriate any money with which to carry out the authorized work.

January, 1937, brought a record flood in the Ohio valley which again centered public attention on flood control and resulted in the appropriation of $94,000,000 by Congress in August of that year, the money to be spent on flood-control projects covered by the act of 1936. The principal work so authorized was in the Merrimack, Connecticut, Susquehanna, Ohio, Red, White, Arkansas, Los Angeles, Columbia, Willamette, Kansas and the upper Mississippi rivers.

This appropriation, in a measure, marks the start of work on the national flood-control program inaugurated by the act of 1936, although a considerable amount of work had been done previously with WPA funds. But obstacles still stood in the way of actual work on some needed projects, chiefly the matter of local cooperation and uncertainty as to jurisdiction over flood reservoirs. The 1936 act put the cost of construction on the federal government but required the local authorities to provide land, flowage rights, rights-of-way, and assume all damages that might arise. This worked in the case of local protective works such as levees, but did not always work in the case of reservoirs, some local communities refusing to buy land and withdraw it from taxation for the benefit of communities downstream.

1938 flood control act

To eliminate the obstacles that were slowing up construction of flood control projects Congress, in June, 1938, passed a new flood control act. It gave the federal government power to build flood control reservoirs and placed on the federal government the cost of land for such reservoirs, flowage rights and channel right-of-way required for flood-control works. Cost allocations for local protective works remained unchanged. Installation of penstocks in any dam at which power may be generated was authorized when such installation was approved by the Chief of Engineers and the Federal Power Commission.

Flood plans revised

In the interim between the passage of the 1936 act and the 1938 act the Army Engineers had been actively engaged in revising their flood-control plans for the river basins covered by the 1936 act. By reference, these plans were made part of the 1938 act. The act authorized an expenditure of $375,000,000 for flood control, bringing the total to $698,877,000.

Concurrent with the passage of the 1938 flood-control act, Congress appropriated $82,000,000 for general flood-control work and $31,000,000 for work on the Mississippi River and its tributaries. The 1938 act also broadened the powers of the Chief of Engineers with respect to the acquisition of land in the floodways along the lower Mississippi River, thus facilitating that work.

Many flood-control operations

The flood-control operations of the present day did not all originate with the flood-control acts of 1936 and 1938. Current work on the lower Mississippi originated in an act of 1928. Work on Muskingum River in Ohio finds its origin in the Ohio Conservancy District Act of some two decades ago, an act that made possible the first comprehensive flood-control operation in this country, that of the Miami Conservancy District. Along the Rio Grande the Department of State, acting under a treaty with Mexico, has been carrying on flood control and channel rectification work for several years. Fort Peck Dam, which is useful in a limited way for flood control, was undertaken as a navigation aid as part of the regular river and harbor work of the Army Engineers. The same is true of the Tygart reservoir at the headwaters of the Ohio in West Virginia, reservoirs at the headwaters of the Winooski River in Vermont, and Conchas Dam on the South Canadian River in New Mexico.

In the Southwest some projects were begun by local conservation districts but now are being financed directly with federal funds or with funds borrowed from federal agencies. These latter projects include the Grand River project in Oklahoma, the Brazos River and Colorado River work in Texas.

Work under the flood acts

Work now being carried out by the Army Engineers under the provisions of the flood-control acts of 1936 and 1938 may be summarized broadly as follows:

On the Merrimack River, in New England, the Franklin Falls reservoir is under construction and some channel improvement has been done through the towns where damage is common in time of flood. Yet to be built are reservoirs at Allenstown, Hillsboro, River Hill and Blackwater before there is reasonable assurance of safety in a major flood.

Many reservoirs are projected for the Connecticut River, twenty in all. Of these Surry Mountain and Knightville are under construction; money has been allotted for work on reservoirs at Union Village, Birch Hill, Tully and Lower Naukeag. A large amount of channel improvement and levee construction has been done along the main river, levees to protect Springfield being nearly complete and at Hartford more than half complete. These would give protection against ordinary floods, but the headwater reservoirs are needed for major floods.

At the headwaters of the Susquehanna, reservoirs are under construction at Whitney Point and Arkport and an early start on the Almond reservoir is projected. Arkport reservoir is substantially completed. Channel improvements at all major cities on headwater streams are under way. Work on levees, intercepting sewers and pumps at Wilkes-Barre is well along toward completion. Adequate protection for some river towns on the Susquehanna against major floods calls for much more work than is covered by present authorization.

A fair start has been made toward flood protection for Pittsburgh, Pa., through construction of reservoirs at the headwaters of the Allegheny and Monongahela rivers, but the present authorizations do not cover adequate local flood protection within the city itself. Reservoirs are under construction at Tionesta, Mahoning Creek, Crooked Creek and Loyalhanna and funds are available for dams on the Yougheogheny and Conemaugh. Ty-

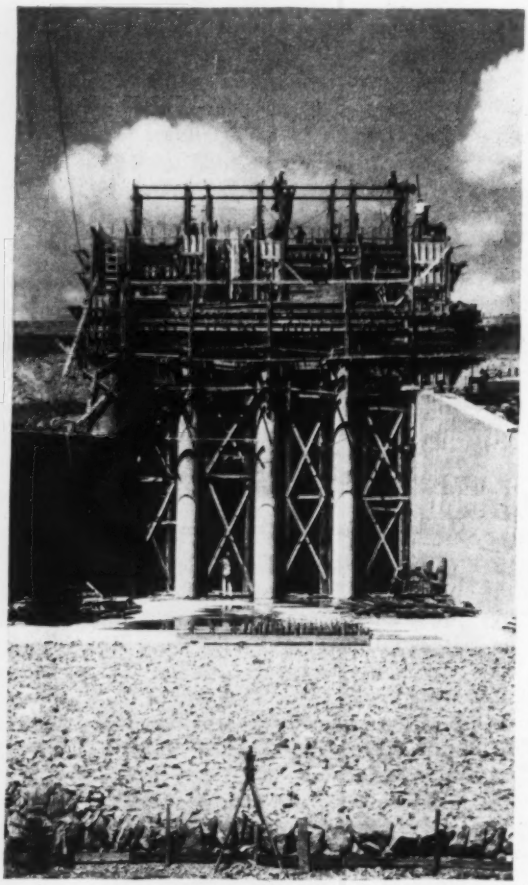
gart Reservoir on a tributary of the Monongahela was completed in 1938. At Johnstown, Pa., famous for its disastrous floods, extensive channel improvement work is about completed.

Elsewhere in the Ohio valley, the surface of flood-control work has hardly been scratched, with the notable exception of two tributaries, the Muskingum and Miami. The Miami work was completed 20 years ago. Construction of flood control reservoirs on the Muskingum was begun in 1934 and fourteen have been completed. Included in the proposed work for next year is $2,000,000 to start work on Dillon Reservoir, one of the three additional reservoirs now proposed to be built in the Muskingum valley.

Other reservoirs for the Ohio valley included in the 1940–41 work are Bluestone on the New River, Dewey on a tributary of the Big Sandy, Delaware Reservoir on the Scioto and Shoals Reservoir on the East Fork of the Wabash. Many more reservoirs on tributaries of the Ohio will be needed before there can be reasonable assurance of large reduction in the crests of major floods, and even then some combinations of storm movements will produce floods of considerable magnitude on the main river that will call for levees and other protective work. As a consequence, the present work includes much in the way of levees and other protective structures in cities along that part of the stream. Substantial progress has been made on these local protection works.

Flood-control on the Tennessee is not covered by the flood-control acts. Storage reservoirs constructed or projected on the tributaries by the Tennessee Valley Authority will do much to reduce flood crests along the Tennessee, and when supplemented with storage behind the navigation dams on the main stem of the Tennessee will help materially to reduce flood crests on the Mississippi. However, adequate flood protection for Chattanooga, the principal city on the Tennessee River, is not assured.

Flood-control work on the lower Mississippi is too well known to call for detailed comment here. Worthy of note, however, is the fact that Sardis Dam in the Yazoo basin, the first storage reservoir on the tributaries of the lower river, is nearing completion, and construction of Wappapello Reservoir on the St. Francis has been begun. Farther to the west, Pensacola, Great Salt Plains and Denison reservoirs all will help to hold back waters of the tributaries.



Outlet structure for Sardis Dam, a flood storage reservoir on the Tallahatchie River in Mississippi.

On the Pacific Coast, the only large-scale flood-control work is that in the Los Angeles region where work on one of the few comprehensive flood-control plans of the country is within sight of its objective. Work there is largely amplification of work begun by the Los Angeles County Flood Control District and includes additional storage reservoirs in the hills, retarding basins on the debris cones and extensive channel enlargement and channel lining through congested areas. Work is in progress on the Los Angeles, Santa Ana and San Gabriel rivers.

On tributaries of the Sacramento River in the central part of California, where the federal government has participated in flood-control work for many years, channel improvement work is being continued and three debris dams are being built.

In Oregon, extensive flood-control work on the Willamette River was included in the flood-control acts. Work to date has been largely confined to channel improvement, but proposed work for 1940–41 includes start of construction on three headwater storage reservoirs, Dorena, Fern Ridge and Detroit. Several other reservoirs are required for adequate flood control on that river.

East of Tacoma, Wash., construction is under way on Mud Mountain Dam, a large flood-control reservoir on the White River.

Elsewhere over the country a large amount of channel improvement and levee constructions is being carried out under the three flood-control acts. Some are adequate to correct a bad local condition but many are useful only for minor floods and must depend for full efficiency upon headwater storage that is not yet assured through appropriation of funds by Congress.

Recent appropriations

Congress in 1939 appropriated $133,000,000 for general work and $39,000,000 for work on the Mississippi and its tributaries during the fiscal year 1940, bringing the total for flood control since the 1936 act to $385,000,000. This year the Chief of Engineers has advised Congress that $207,000,000 can profitably be spent on general flood-control work and $50,000,000 on the Mississippi and its tributaries. The President put the total at $100,000,000 in his budget message. Even though Congress in its present desire to be economical should cut the budget figure the Army Engineers have their work so planned that it can be adjusted to protect the investment already made in flood control.

Bridges and Buildings

WALDO G. BOWMAN

WHAT HAPPENED to bridges and buildings, structural-wise and architectural-wise, in 1939 is relatively easy to state. Why it happened or whether it is significant presents a more difficult task. Furthermore, what happened can be pinned down precisely to a 12-month period whereas the why and the wherefore is inextricably woven into a flowing pattern of development that reaches back into the past. One can, however, recognize certain accents in this pattern that rose above the surface during the year and which, therefore, can be considered to belong to 1939.

Three of these accents are particularly worthy of note. Chronologically they were W. M. Wilson's report on fatigue tests of welded joints, the Davis, Woodruff, Davis paper on large riveted joints, and the final report of the committee on wind bracing in steel buildings of the American Society of Civil Engineers. Each of the studies concerned was of several years' standing but the reports brought forth the results and appraisals for the first time. Already the new facts are being related to design.

The fatigue studies revealed strengths below the yield point for joints subjected to a large number of cycles of stress reversal and to wide variations in repeated stress; values were about 20 per cent lower than those obtained a year previously for riveted joints. A new set of working stresses is obviously suggested, both for riveted and welded work, but designers have been quick to point out that they should only apply to the members directly involved and not to the whole structure. Also suggested by these studies is that live load variations in members carrying large dead load are probably of no consequence so far as fatigue danger is concerned.

The tests of large riveted joints provided assurance that design practice, heretofore based only on small joint test results and on experience, is amply safe but that nothing is gained by using elaborate formulas to evaluate the effect of rivet pitch or net section, since the section at the row having the greatest number of rivets is the one that correlates best with strength. Uniform distribution of load among all rivets was shown to be a safe and sensible assumption.

The wind bracing committee in recommending a straight line increase in design wind pressures from 20 lb. at 300-ft. height to 50 lb. at 1,500 ft. and in stating a preference for the Spurr method of design laid the groundwork for a rational, safe and uniform procedure for tall buildings, if and when we build any more.

It is becoming trite to say that continuous structures enjoyed increased popularity. Such a trend has been in evidence for a decade, but each year records developments in design procedure. Many if not most of them hark back to the Hardy Cross method of moment distribution, and 1939 witnessed the introduction of a particularly interesting variation, the Grinter "direct" or "automatic" design method in which section moduli rather than moments are distributed. Its outstanding characteristic is that

Large gusset plates impart striking appearance to towers of 300-ft. Newtown Creek span in New York City's mile-long Meeker Ave. elevated highway.

it permits, even requires, the designer to appreciate that he is adjusting the structure and not merely juggling a set of figures. The true designer has always had a "feel" for his structure but too many of the necessary short-cut methods in indeterminate structure design have tended to insulate him from this feeling.

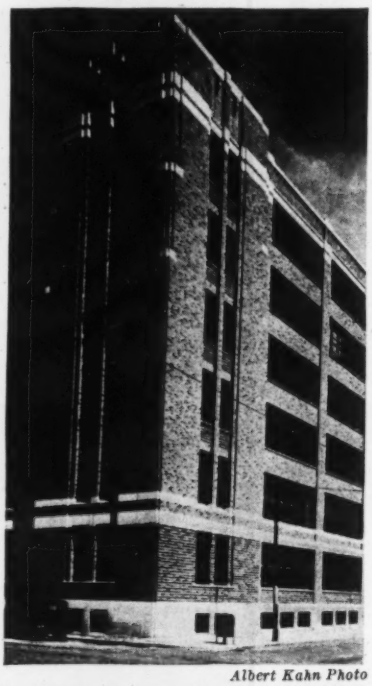
Earthquake-resistant design methods have become routine on the Pacific Coast, and are being actively discussed elsewhere. The more frequent, widespread and destructive quakes which marked the year, and particularly those which occurred in Chile and Turkey, may have stimulated this interest. During the year the U. S. Coast and Geodetic Survey brought to 50 the number of strong-motion seismograph installations in the Western States and also installed three tiltmeters as an aid in studying the possibilities of earthquake prediction. Sensitive microphones suspended in deep wells to pick up earth movement noises are also being used in this study.

Some general trends

In reinforced concrete frames, where continuity is inherently present, a wider familiarity with indeterminate design has been particularly beneficial, permitting better proportioning of joints, relief of highly stressed areas and consequent reduction of cracking. Slab design has continued to attract much attention as a result of detailed methods incorporated in the new A.C.I. code, although such refined and mechanical procedures were challenged by a number of experts who claim that static methods of moment determination, seasoned with design judgment, produce as good or better results than the indeterminate analysis. Developments of the year made it plain that more will be heard on this question. Resurrection of the study of bond strength was a development of the year brought about by a need to evaluate the effect of drier concrete mixes placed with the aid of vibration and of new types of steel reinforcement. Controversy over the economies and usefulness of high-strength bars occurred during the year and may be expected to continue. Prestressing of steel reinforcement to reduce cracking was also actively discussed.

In steel, the wide use of the plate girder form was notable. Long span bridges, arch ribs, rigid frame bridges, viaduct bents and suspension bridge stiffening girders represent applications where heretofore the trussed member had almost exclusive reign. As a consequence the stability of web plates against buckling has emerged as a necessary problem to be solved. Important studies were under way during the year on the application of a theory of elastic stability to this problem, looking toward a rational use of stiffeners for those members whose dimensions go beyond the point where a thickening of the web plate will give the necessary strength.

Cold riveting is being practiced more and more, and investigations in this field are certain to affect design. Painting of steel was a live subject during the year, new paints being introduced and considerable tonnage of steel being prepared for painting by descaling and dehydrating, using the oxy-acetylene torch. Timber as a structural material continued to make rapid strides. A design competition for bridge trusses brought out a number of ingenious details making use of metal shear-dowel connectors.



Albert Kahn Photo

New Detroit home for Parke-Davis & Co., drug manufacturers.

A number of specific bridges and buildings, completed or under way in 1939, reflect some of these design advances or incorporates features that suggest new trends. Cleveland's Main Ave. Bridge, in its elaborate traffic-sorting approaches made history by utilizing several all-welded rigid frames (some with plate girder and some with rolled section elements) and a continuous plate girder layout that includes the longest span in the U. S., 271 ft.

Slender suspension bridges

The Tacoma Narrows suspension bridge marks a distinct advance in suspension bridge design by virtue of its great length-width ratio (72:1) and its use of plate girders for stiffening members, following in bolder fashion a precedent set by the Whitestone Bridge at New York and bringing into play new knowledge which takes account of the inherent stiffness of the cables themselves and the proper reinforcement of the girder webs and the floor system to resist lateral wind loads. The year witnessed the completion of the country's fifth self-anchored suspension bridge, a 350-ft. span structure across the Wabash River at Hutsonville, Ill. The Wichert continuous truss, whose use of a pinned quadrilateral panel over the points of support makes it statically determinate, found application in bridges over the Susquehanna (36 spans) and Potomac rivers (25 spans). At Rock Island, Ill., the Mississippi River is being spanned by a series of five tied steel arches, with spans up to 539 ft. The only other recent bridges of this type have been the 425-ft. Connecticut River span at Orford, N. H. and the 360-ft. Canal St. span in New York City. Failure of a Rio Grande suspension bridge at Hidalgo, Tex., and the necessity for replacing the 12-yr.-old cables on the Ohio River crossing at Portsmouth gave rise to new speculations on wire properties and protection from corrosion.

In the concrete bridge field the most notable structure is the pontoon crossing of Lake Washington at Seattle. Here, by careful concrete control, watertight compartmented barges are being built, which when joined together by ingenious connections will provide a 45-ft. roadway across a body of water whose depth and mud bottom successfully challenged the economic construction of a pier-supported structure. In this same part of the country, long span hollow concrete girder bridges are continuing to be built at surprisingly low costs. An attempt to build an 866-ft. concrete arch in Sweden, 254 ft.

Billed by the Rock Island Railway publicity department as the "Samson of the Cimarron," this main line bridge near Liberal, Kan., was part of the biggest railroad construction job of the year, a line change that saves 4 miles.

longer than the longest yet built, proved unsuccessful when the timber centering failed after about half the structure was in place. Articulated end spans were introduced on some California bridges to provide means for adjustment of abutment settlement.

In buildings, continuity in steel frames found expression in the Bankers Life Bldg. in Des Moines, where rigid column connections and beams continuous through the girders were used to reduce floor framing depth. More large welded buildings were built than for a dozen years past, a 23-story structure at the Jersey City Medical Center setting a new record for height and a multi-story factory building at Syracuse using heavy connections that carry 250-ton reactions.

New building materials

Among new materials, the use of enameled steel sheets for exterior walls of a high school in Girardville, Pa. and the use of thin precast exposed aggregrate slabs made in water-absorbent molds for the naval testing basin building at Carderock, Md., were notable. These architectural slabs were also used for bridge abutment facing and, with polychrome mosaic patterns, for interior wall covering. The Carderock naval building was perhaps the outstanding concrete structure of the year for, in addition to the architectural slabs, it incorporated a 110-ft.-span arch roof nearly a quarter of a mile long equipped with three Mesnager hinges. The use of thin concrete shells for barrel roofs and domes was extended during the year, an industrial building, a skating arena and a university auditorium being among the larger structures utilizing this construction.

The problem of cracks in building bearing walls of brick carrying concrete roof and floor slabs was actively considered during the year and diagnosed to be a result of slab shrinkage. Attempts were made to eliminate cracks by stiffening the slabs with edge beams, by placing vertical concrete struts at the building corners and by using peripheral reinforcement in the slabs. A test building was built by the USHA and the Bureau of Standards in Washington to study these and other methods of crack control.

Air conditioning is rapidly assuming a "must" status in buildings, causing variations in framing, in wall and roof details, window layouts and in mechanical facilities. Insulation is of course a necessary corollary of air conditioning. Some buildings have reduced window areas drastically—a General Motors building in Indianapolis eliminating them entirely and a Church & Dwight Co. building in Syracuse using only a few, supplemented by a number of glass block wall and monitor panels. This latter building exhibited new mass and facade effects for industrial buildings that come nearer than any to resembling the strikingly modern concepts that have heretofore appeared only on imaginative renderings of what the building of the future would look like.

Record Year for Transport

CHARLES S. HILL

TRANSPORT OF ALL KINDS recorded notable advances in 1939. Passengers and goods carried by airlines, railways and public roads showed a sharp upward trend in number and volume. Travel mileage increased; safety of travel increased; the number of airplanes, railway cars and motor vehicles in service increased. Income and earnings were greater than in 1938 or several years previously. In all these indices of progress, air transport took a commanding lead over road and railway transport in rate of increase. But for all transport 1939 was a year of good omen for future business development.

For the construction of new facilities public roads surpassed all other forms of transport in the amount of money expended. Works for internal navigation ranked next, but the year was chiefly notable for the near completion of two great river navigation projects. New railway construction, boosted by federal grade-crossing improvement, followed navigation works in volume, and airport building came last.

Aviation's banner year

Air transport recorded its year of all years in 1939. Airline revenue-passenger miles in 1939 reached the all-time high of 677,325,511, an increase of 42 per cent over 1938. The number of civil airplanes increased to 13,772 or an increase of 24 per cent over 1938. The number of certified civilian pilots increased 37 per cent to 31,264. The airline travel record was 82,000,000 miles per passenger fatality. New airline development of any magnitude was limited to transatlantic service, the astonishing increase of which to a contemplated daily schedule is one of the marvels of air transport. In mail service, the year introduced the pickup airline in a limited trial area to collect mail at cities without airports; dipping down in its flight the plane lowers a cable to which the mail container is attached.

Airport construction continued actively, the two notable examples being the $40,000,000 La Guardia field at New York and National Airport at Washington estimated to cost about $15,000,000. But airport improvement was general and provided a wide range of construction work. During the year the WPA spent $41,000,000 and sponsors contributed $21,000,000 mostly for civil airport improvement. Contracts also began to be let for the navy $63,000,000 and the army $58,000,000 program for new airbases.

Railways lack funds

The year 1939 continued to pile up evidence that the railways are still far from reaching the level of prosperity that is needed to attract new capital for modernizing track, terminals and equipment. Increasing rail traffic, that in the latter half of 1939 consistently topped the 1937 and 1938 figures and lifted number one railways out of the red, gave rail management some encouragement as to the future. Bright spots also in the rail-transportation picture were: The President's proposal to Congress that shipping be charged a toll for the use of harbors and waterways on which the government spends many millions annually; reasonable assurance that all forms of transportation will soon be under the control of the Interstate Commerce Commission, where equality of opportunity ultimately will be possible, and evidence that the commission is now inclining toward removing some of the restrictions that have kept the railroads from adjusting their rate structures to meet competitive conditions.

Financial conditions limited new construction almost entirely to line relocation necessitated by reservoir construction for flood-control, water or power projects and to grade-crossing elimination, which latter work now is financed in large part by the federal government. Such new construction as was undertaken was marked by greater mechanization than heretofore and by the application of the principles of soil mechanics to fill construction.

Water transport

At the close of the year canalization of the upper Mississippi from the mouth of the Missouri River to the Twin Cities was nearing completion. On the Tennessee River, the completion of more dams by the Tennessee Valley Authority lengthened the section of the river suitable for modern barge traffic, but the river will not be opened to barge traffic from the Mississippi system until the completion of Kentucky Dam (formerly Gilbertsville) near the mouth of the river, a project that now is under construction. On the lower Mississippi construction primarily for flood control but also as an aid to navigation advanced actively as told on another page. The outstanding gain to navigation was the development to full capacity of the cutoffs that have greatly shortened and straightened navigation channels.

The work of deepening and widening the Cape Cod Canal and the Chesapeake & Delaware canal was nearing completion at the end of the year, and deepening and widening were in progress on sections of the Intracoastal waterway along the Gulf of Mexico to accommodate local movements of oil and sulphur. About mid-year, Congress authorized the construction of a third set of locks for the Panama Canal, but as yet has not appropriated any funds for construction.

Road transport active

The year presented striking evidence of the increasing stability of the nation's highway improvement program. The records are conclusive: in 1938 expenditures varied only 1½ per cent from 1937; in 1939 they varied only 2 per cent from 1938, and the budgeted expenditures for 1940 vary only 6 per cent from the reported expenditures of 1939. In

this last year state highway departments constructed 30,428 miles of road of all types and expended $719,262,000 for construction and maintenance. (For a complete breakdown of these figures see *Engineering News-Record*, Jan. 18, 1940). Type trends continued, as in 1937 and 1938, to show a preponderance of bituminous construction.

In financing, the greatest problem continued to be diversion of road tax money to non-highway purposes. The gasoline tax paid to the states in 1939 was about $815,000,000 and license fees amounted to about $390,000,000, and estimates are that there was a diversion of about $170,000,000 of these moneys in 1939. During the year, however, organized opposition to diversion gained strength and the outlook for the protection of road-tax funds for roadbuilding was a little more encouraging.

Few changes were suggested in gasoline tax rates but the trend continued toward reduction of automobile license fees but no reduction of truck fees. Spread of the license tax take by deferred (from Jan. 1) registration, was provided in seven new states; the total on Jan. 1, 1940, was 25 states. Bonds for highway financing other than toll revenue projects were small in amount and almost as many states refused to vote road bonds as there were states that approved new issues. The most important action was in Illinois; permission granted to Cook County and Chicago made possible a $60,000,000 bond issue for a system of superhighways. Generally, 1939 gave no great encouragement to roadbuilders that the sinews of war derived from taxes would be more plentiful.

Meanwhile a movement toward financing special road improvements by toll charges gained favor among many public officials. Generally these toll projects have been city tunnel and bridge entrance roads of short length and high cost, but so hopeful an easy-money plan for superhighway building shows signs of not being confined to these legitimate purposes. Outstanding in the year's toll roadbuilding was the 160-mi. turnpike across the western Pennsylvania mountains. A bond issue to be retired by toll charges and a federal grant are financing this new four-lane divided highway.

A more striking example of toll-charge extension was the application of tolls to travel on the Merritt Parkway in Connecticut already virtually completed for 38 mi. with motor-vehicle tax funds. This toll charge ostensibly was to help continue the Merritt Parkway as the Governor Cross Parkway to the Massachusetts line. Incidentally and perhaps prophetically, a repercussion of the Connecticut action was a retaliatory toll imposed by Westchester County, New York, on the New York connection to the Merritt Parkway.

Modern routes of transportation meet in the mountains of Nevada. The road in the foreground is the reconstructed Victory Highway, work done in 1939.

Both of these toll roads exemplify a design practice, which became standard in 1939, of separating the two twin traffic lanes of four-lane roads by a parkway or median strip. This practice brought new design problems to highway engineers particularly in respect to width and structure of median strips. The year recorded two notable developments. That of most importance was a determination of median strip widths at intersections based on a rational design study made by a committee of the American Association of State Highway Officials.

A second development was final settlement on two cardinal principles of curb design—surmountability and visibility. Nowhere except in city streets, or other very special locations, are vertical or high curbs recognized good practice. Low inclined curbs that can be safely surmounted by a wild car are held essential. In curb visibility exceptional advance was made in light-reflecting curbs of white cement. These developments were mostly on arterial roads.

In general, arterial roads had in 1939 more consideration of a fund-

amental nature than was ever before given them. Few new projects were actually advanced but early in the year the Public Roads Administration came out with its notable plan for 26,700 mi. (since increased to 29,300 mi.) of regional highways, city access roads and federal right-of-way financing that marked one of the most far-sighted advances in road planning since the federal-state planning survey was inaugurated in 1936.

The field research work of this survey neared an end in 1939 and active progress was being made in working up the field notes. Some of these data were used in developing the regional road plan.

The year also saw planning by the War Department and the Public Roads Administration of an 80,000-mi. system of arterial roads for war service embracing the regional road system and additional roads equally important as arteries of commerce. Some legislation was tentatively drafted looking to the prosecution of the federal right-of-way financing plan suggested in the regional-road report but no legislative action was moved.

In ordinary pavement and graded roadway design and construction there were few new developments but a general extension of refinements already adopted. These included wider traffic lanes, flatter curves, longer sight distances, flatter shoulders, shallower ditches and rounded backslopes. Surfacing practices took on more refinement in materials and workmanship. Brick road-building extended its experiments with brick laid longitudinally and with vibrated monolithic construction. Soil stabilization continued an outstanding practice in earth road-building and base construction for paved surfaces. Construction technique changed in no essential but all operations were more extensively mechanized.

Government support of roadbuilding continued with regular federal aid and with loans and grants by the PWA and the WPA. No new federal legislation developed.

Hydro-Electric Power

N. A. Bowers

Most water power developments of late years have been federal projects or have had federal aid. In some cases power has been the primary purpose, in others it has been the by-product of flood control or navigation. With the federal government in the power business or directly interested in it, there has been a natural tendency to foster the development of new public utility districts or to encourage those already organized. The Tennessee Valley Authority is the most outstanding example of this, but such districts have made considerable headway in Oregon and Washington. With the advent of the Central Valley project, a similar tendency is markedly in evidence in California where high state officials have announced a policy of encouraging organization of power utility districts. This situation has naturally tended to induce private utility systems to make any needed additions to capacity by building steam plants.

The Pacific Gas and Electric Co. in northern California wants to build hydro plants on the north fork of the Feather River but, although application for the necessary licenses has been before the Federal Power Commission for several years, no decision had been handed down by the end of 1939 and current opinion is that reason for the delay is the desire of government officials first to conclude marketing arrangements for power from the Central Valley project. This, despite a written offer of the private power company to absorb all available Central Valley power for a five-year period.

A new trend noted

While this question of licenses is pending and federal as well as state encouragement of utility districts is under way, construction is being rushed on three 50,000-kw steam plants in northern California which mark a notable new trend—cooperation between power company and large steam-and-power-using industrial customers. These stations are being built adjacent to three large oil refineries where they can utilize refinery waste for fuel and supply quantities of steam and power in exchange.

Because the Central Valley project is planned primarily to control streamflow, and power development must be a secondary matter, only a small part of the installed generating capacity can be made available as firm power. This situation would make it natural for the Federal Power Commission and the California Water Authority to look with favor on the development of steam power plants by private utilities. Such steam plants, always built in load centers and usually where tie-ins can be made conveniently, not only tend to firm up such power outputs as that from Shasta Dam but they constitute valuable insurance against outages resultant from delivery interruptions on long transmission lines.

Shasta Dam affords an example of a factor that must henceforth be considered in the power situation; namely, the utilization of large quantities of "dump" power that will be available from federal-aid projects whose primary function is in other than the power field. Although most of the Shasta power will not be in the firm classification, in this particular instance, fortunately, most of the surplus will come at a time coinciding with the demand for irrigation pumping.

In the Pacific Northwest, there is speculation as to whether the Bonneville and Grand Coulee projects will result in another TVA experience. The Bonneville power administration is building a federal transmission grid in Oregon and Washington. Although the Bonneville plant

has been ready to deliver power since August, 1938, up to January, 1940, actual power contracts had amounted to 59,000 kw. The first sizable sale was not made until Dec. 1 when the Portland General Electric Co. contracted for 10,000 kw, has been taking considerably more, and is using dump power to save operation of steam plants.

Bonneville has an installed capacity of 132,000 hp and is adding four units of 74,000 hp bringing the total to 428,000 hp.

However, hopes of Northwesterners that low-cost Columbia River power would stimulate industrial development, thus providing new payrolls, population and markets, got material encouragement in the recent contract for Bonneville power made with the Aluminum Company of America. This company plans to build a plant at Vancouver, Wash., and selected the rate of $17.50 per kilowatt year delivered from the federal transmission network instead of taking this energy at the Bonneville bus bar rate of $14.50 per kilowatt year. This Aluminum Co. contract, starting with 32,500 kw, marks the first actual consummation of the large-scale power use that has been cited for a quarter of a century, as an inducement to industrial development in the Northwest. There are current rumors of other large-size contracts "soon to be made."

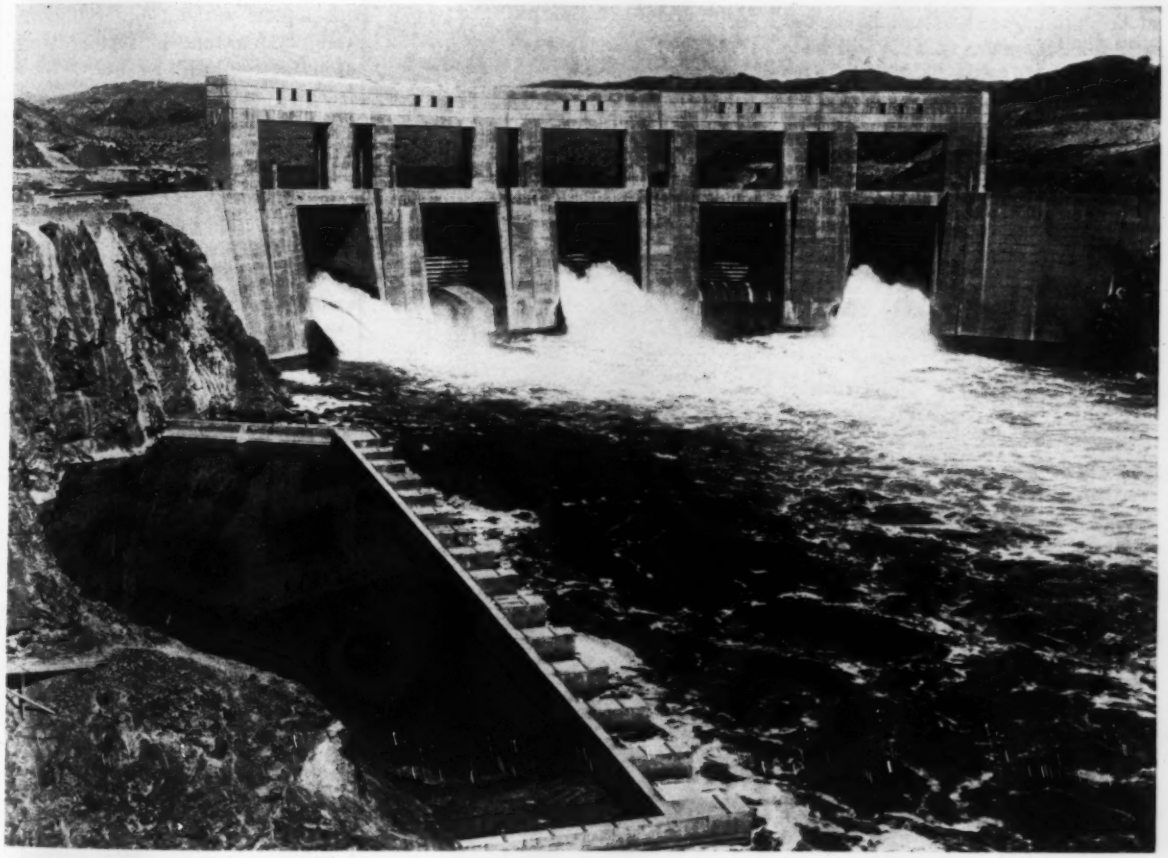
Grand Coulee power

Meantime, construction goes steadily forward on Grand Coulee Dam from which an enormous block of power is expected to be available in a few years. Whether this will be distributed over a triangular transmission line with the three corners at Grand Coulee, Bonneville and the Skagit projects remains to be seen. At least, transmission line construction between the two Columbia River plants is under way and a considerable mileage northward from Bonneville is under contract. Delay in agreement on such a transmission program may be due to the coolness with which the large municipal power systems in Tacoma and Seattle regard the announced Bonneville plan of supervising resale rates and system-operation of its wholesale customers.

Six public utility districts have been formed in Oregon and 28 in Washington. These organizations have been encouraged by a court decision which gives the Washington districts authority to condemn and purchase with revenue bonds distribution facilities of private companies, without submitting the issue to the voters.

In Southern California the ultimate full utilization of Boulder Dam power is presaged by the installation of steam generating facilities by three of Boulder's customers—the municipalities of Pasadena, Glendale and Burbank. Incidentally, Glendale and Burbank are building outdoor steam stations, new to the West but well adapted to its climate. These mark the first steps of a move that may become popular.

Long-range power transmission from Boulder Dam to Los Angeles has been notably successful over the 287,000-volt transmission line 266 mi. long. In 1939 the original two-circuit line of the Los Angeles Bureau of Power and Light was supplemented



Parker Dam on the Colorado River. Construction of a powerhouse within the enclosed area at the left has been authorized.

by a third circuit built by the Southern California Edison Co. to convey 150,000 kw to its system. A fourth circuit, primarily for the Los Angeles municipal system, was started during the year and about 55 mi. of the line completed.

During 1939, two 115,000-hp. units were put into operation in the Boulder Dam power plant, making an installed capacity of 975,000 hp. out of an ultimate 1,835,000 hp. Six 115,000-hp. turbines are now operated by the Los Angeles Dept. of Water and Power, two 115,000-hp. turbines by the Southern California Edison Co. and one 55,000-hp. turbine by the Nevada-California Power Co. Two additional units now being installed are scheduled for operation early in 1941.

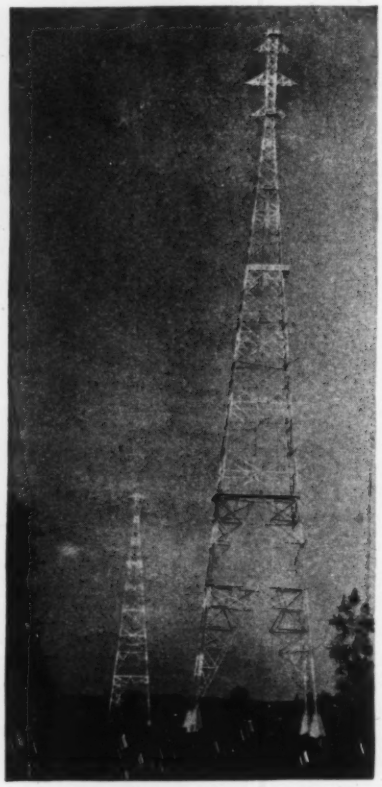
In anticipation of completing a generating plant at Parker Dam, transmission lines are under construction from Parker to Phoenix, and to Yuma, Ariz., where a major customer will be the Gila project. An interesting phase of these new lines is that pending completion of a power source at Parker, the transmission line from Boulder to Parker, previously used for delivery of construction power, can transmit Boulder power for Arizona uses. This will be particularly valuable in the 1940 irrigation season in the Salt River Valley where it is expected there will be need for outside power for pumping.

Although power production in the electric light and power industry is up 12 per cent over 1938 (38 per cent more than in 1929), according to C. W. Kellogg, president Edison Electric Institute, generation of electricity by water power was 4 per cent less in 1939 than in the previous year. This is ascribed in part to drouth and is reflected in the 22 per cent increase in steam power production over 1938. Significant in the Kellogg report is the item of only 70,000 kw additional hydro capacity planned by the electric light and power industry for 1940 as against 1,415,000 kw which is the proposed addition on government projects.

Canada has increased its water power developments only slowly, yet the total has grown to sizable figures and the Dominion Water & Power Bureau recently announced the total installed capacity of Canadian water power plants at the end of 1939 as 8,289,121 hp. Included in this is the ninth unit at the Beauharnois Plant on the St. Lawrence River and it is announced that the tenth and eleventh units are under way. When these are installed, the capacity will be close to 600,000 hp. This is more than the capacity of the Queenston Plant at Niagara Falls and is second only to Boulder Dam, which has 975,000 hp.

Hydraulic turbines and pumps

With respect to hydraulic turbines themselves, perhaps the most outstanding event of the past year was the award of contract for three 147,000-hp. units for Grand Coulee Dam. These are notable for the considerable increase in size over the 115,000-hp. units at Boulder Dam. Complete operating satisfaction is reported on the 66,000-hp runners at Bonneville which, by reason of their low head, have the record diameter of 23 ft. 4 in. The extremely high head developments common in the West some years ago have been notably absent in recent years. Hence the more attention is drawn to a U. S. record for static head in the small plant installed in 1939 for the Manti City Corporation in Utah. In this plant a static head of 2,614 ft. operates a 532-hp. turbine at 512 rpm. The project is a plan for joint development of water supply and power; it is served by a pressure pipeline 28,500 ft. long.



Towers 521 ft. high for the Columbia River crossing of one of the transmission lines from Bonneville Dam.

Studies of pump model efficiencies at California Institute of Technology, made in connection with the very large-sized pumps proposed for lifting irrigation water at Grand Coulee, contain special interest for hydraulic designers because of the close relationship between pump and turbine runners. This investigation closely follows the study of runners for the Metropolitan Water District conducted in the same laboratory.

Some of the notable items of progressive development in water-wheel design are the increased use of water-lubricated bearings on large hydraulic turbines, the venting of draft tubes through propeller shafts and progress in the design of movable-blade propeller turbines, notably automatic adjustments to direction of flow, doubtless attributable in part to developments in aerodynamics.

Federal power uncertainty

No survey of the hydro-electric power situation in the country would be complete without observing that a major deterrent to further water power development by private companies is continued uncertainty as to the authority of the Federal Power Commission. Acceptance of a license from the commission for a power project includes acceptance of a condition that the plant can be taken over by the federal government at the expiration of the 50-yr. license period. The Federal Water Power Act gives the commission the right to require a license for all new plants on navigable streams, but the commission has extended its interpretation of "navigable" to include non-navigable tributaries on which interruption of flow might affect the navigability of the stream below. A test case challenging the commission's jurisdiction over such streams —the New River case—has been in the courts for years now without a controlling finding by the Supreme Court. In November the U. S. Court of Appeals ruled against the commission, holding that the New River is not navigable and so beyond the jurisdiction of federal government. If the Supreme Court upholds the Court of Appeals considerable water power work may be put on the books of private utilities.

The Year in Research

F. E. SCHMITT

CIVIL ENGINEERING ADVANCE rests increasingly on research, as construction undertakings grow more complex and make higher demands for refinement to assure safe, efficient and economical results. Today it is necessary to study natural actions more thoroughly than in the past, to improve materials and methods, clear up unknown or uncertain points of design and procedure, and find forms of construction better suited to service needs. Responsive to such demands, 1939 brought a steady increase in civil engineering research activity, carrying forward the advance of the past decade or two. It revealed also a gain in organization and coordination of research efforts.

Fundamental research—that devoted to study of basic physical actions or the solution of a general problem—does not stand alone in the year's contributions. Even more work was done in applied research and in engineering investigation of specific problems of practice. Nearly every large piece of construction includes elements in which the methods of the past do not assure adequate performance or greatest economy, and therefore special studies to find a better method or more efficient design are often resorted to.

A typical case of applied research reported during the year is found in the strength tests of large riveted joints for the San Francisco Bay Bridge. These tests showed that the least net section of a joint determines its strength, largely independent of stagger, spacing and stress concentration. Two of our leading construction organizations are among the largest contributors to the current volume of applied research—the Bureau of Reclamation and the Army Engineer Department. Reclamation carries on an imposing program of tests and studies on elements of dams, canals, bridges gates, valves and penstocks. The Army Engineer investigations include among other things verification tests of projected river and harbor changes, levee foundations, earth and concrete dams, and paints and other service materials.

Closely related to research is the development of engineering practice through trial-and-error procedure or inventive ingenuity. Such development often merges into research, as does also much of the work done in perfecting construction equipment and in improving materials and production processes.

In the following review of research activities, emphasis has been laid on work in progress rather than on results. It will be understood that such a review cannot be comprehensive. Names are given only in occasional instances.

Many materials under study

Before individual construction materials are considered, the investigation of complete dwelling-house elements that has been in progress at the Bureau of Standards for two years should be noted as a major piece of cooperative research. To date 32 elements of wood, 25 of masonry and 20

of steel, mainly walls and floors, have been tested. Conclusions useful for low-cost house construction are still in the future.

Specific materials may well begin with timber. Forest Products Laboratory tests of ring-connector construction determined end and side margins, spacing of connectors and best thickness of the wood members. Laminated construction was further studied for effect of initial stress and proportions of scarf joints. Chemical seasoning by impregnation with urea and other salts reached the practical stage, as did plywood production with phenol resins.

In the field of brick, strength and other properties bearing on wall loads and durability received further study. Long-time exposure tests at the Bureau of Standards indicated that occasionally deleterious substances are contained in brick. Wide variation in the weather-resistance of different bricks was found, and present results indicate that a low ratio of long-time absorption to short-time absorption should be sought for durability. Tests of brick mortars are also continuing, including their effect on masonry.

In structural steel the material itself presented fewer urgent problems than its application. However, high-strength steel of special corrosion resistance is being sought for, and the characteristics of cold-driven rivets that will give adequate fatigue resistance are being investigated. Corrosion testing is proceeding on an elaborate scale. Sheet corrosion results confirm earlier conclusions that copper-bearing material is superior in atmospheric but not in water exposure. Corrosion of water pipe has been found to be affected by the mineral salts in the water.

Corrosion testing of non-ferrous materials became fully as active as that of steel, and the past year directed particular attention to the effect of metal couples. A coordinating committee on corrosion has been formed.

Cement and concrete continue to be major subjects of investigation. Damage to concrete pavement surfaces by chemical thawing and by ordinary freezing and thawing led to investigation of wetting, emulsifying or expanding admixtures to cement, with conclusions still uncertain. Chemical action of cement alkali on some California aggregates was found to

cause abnormal expansion. In more fundamental cement study, X-ray and microscope were applied to verifying compound formation.

The proper fields of use of different types of cement are being studied by laboratory and field observation, largely in connection with irrigation structures. Puzzolanic admixtures were found by several investigators to reduce shrinkage cracking, and a local puzzolan admixture was adopted for quality and economy at Friant Dam.

Concrete investigations ranged over a broad field, covering aggregates, grading, mixing, compacting by vibration, strength, bond, and resistance to abrasion and weathering. A research into bleeding, analyzed as a sedimentation problem, showed that water control and a high ratio of subsieve fines are major factors in reduction of bleeding. Bond studies confirmed the value of roughness and low water ratio, and showed moderate rusting of bars not harmful.

A new method of measuring concrete shear strength and pore pressure was put to use, applying the triaxial compression principle used for soils. Previous studies of cement-bound macadam were applied in the trial use of grouted ballast for railway roadbed. Development of absorptive form lining for Reclamation Bureau dams followed special research that showed the weakening effect of excess water at concrete faces.

Progress was made on the vexatious problem of getting full bond at horizontal construction joints in dams.

In the TVA as well as Reclamation work, field study of the structural action of large dams by embedded strain gages is under way.

Structural research

A significant publication related to research was made during the year by the Bureau of Reclamation, in the form of two more volumes on Boulder Dam studies, one of them covering stress studies, the other slab analogy experiments. Another notable document was a final report on wind pressures and wind bracing of buildings by a committee of the American Society of Civil Engineers, which recommends pressures up to 50 lb. per sq. ft. for exposures at considerable height above the ground and calls for considering the effects of wind suction and torsion.

Studies of railway bridge impact with attention to damping were begun at Ohio State. The action of slabs on elastic foundations independent of linear pressure-deflection relations was studied at the Bureau of Reclamation. Tests of bridge floor slabs to study the effect of stringers and curbs are in progress at Illinois. Photoelastic stress investigations were used extensively in both research and industry laboratories to measure stress intensity and distribution in structure as complex as gate-valve disks; in one case a three-dimensional method of study was applied.

Wall sections are tested under eccentric load in the big vertical machine at the Bureau of Standards to help in developing low-cost house construction.

Specific items of research in structural elements included tests of riveted web splices of girders at Columbia, which showed simple splices to be stronger than the girder itself; standard beam connections in riveted frames; openings in cover plates at the Bureau of Standards and the Bureau of Reclamation; efficiency of girder stiffeners at Ohio State; distribution width of concentrated loads on laminated wood floors at Illinois and strength of short steel columns at Lehigh. Completion of tests of rigid frames indicated general agreement of results with current design principles. Studies of various shear connectors in composite wood and concrete beams, which are finding use in the highway bridge field, were begun.

Talbot's monumental railway track research, begun more than 25 years ago, continued its active progress, with special attention to the slipping and bouncing of locomotive drivers at high speeds and the behavior of rail joints under fatigue action of rolling loads. Little less prominent is the Illinois research into the problem of transverse fissures in rails, now eight or nine years old. The previous finding that fissuring can be controlled by slow cooling of rails has been verified by several years' track experience, and current studies deal with the effect of rate of cooling, end batter, and a bend test as means of rail improvement.

Welding research showed the static strength-reducing effect of residual stresses to be negligible. The weldability of alloy steels and suitable methods of welding them still hold the interest of research men. Continuing interest in clearing up the problems of structural welding was evidenced by the formation of a new committee to carry on research in this field.

Investigations to explain the failure of the welded Hasselt Bridge in Belgium were concluded, but the results are not yet known. Advance reports suggest that the welds were poor.

Earthquake study in relation to structures was furthered by installation of additional seismometers and more sensitive seismographs near Lake Mead (Boulder Dam). Analytical research dealt with stress calculations and design procedure for dams and bridges, primarily in connection with the Central Valley project.

Road pavements and traffic

Outstanding among road studies, though somewhat different in character from most research, is the nationwide highway planning survey. It is still largely in the stage of gathering data, though tentative conclusions are gradually emerging.

Road research engages a large number of the laboratories of the country and covers many subjects, from materials and construction methods to traffic layout and economics. The Public Roads Administration laboratory leads in this work.

Resistivity and seismic subsoil exploration have been found useful in locating rock strata and gravel deposits; their study is continuing. Concrete pavement design is under investigation both by field surveys and by an experimental pavement comprising longitudinal reinforcement and various lengths of slab, with the tentative showing that slabs up to 1,300 ft. are feasible. The impact elasticity of concrete pavements is being investigated. Instruments to measure and record road roughness are being perfected.

In the field of non-rigid pavements, measurement of pressure distribution to the subgrade indicated that substantial pavement thicknesses are advantageous. Culvert study has been concerned with the strength of flexible pipe in fill and with the erosion resistance of bituminous coatings. Expansion and contraction joints, curbs, signals and guard rails also received further study, much of it through service observation.

Virtually all road materials were under continuous research during the year for their numerous factors of serviceability. Aside from the study of cement admixtures to promote pavement durability, investigations dealt with abrasion-resistance of aggregates, effect of various pavement-curing materials, and accelerated weathering of bitumens. Study of paving asphalts from different sources revealed differences not shown by the usual tests. Properties of cutback asphalts were more closely defined for specific services by new specifications based on research and experience.

Some 350 miles of fabric-reinforced pavement are under observation and test. In Oregon, skid resistance and visibility of pavements were found highest for rough surfaces. Observation of ground subsidence under high fills was begun at Iowa State, and tests to determine the shearing strength of slabs under concentrated loads are under way.

Transportation and traffic research included more precise study of effect of road surface on cost of vehicle operation, which showed that pavements save the user up to 1c. per mile, and of the cost of congestion, which approaches ½c. per mile.

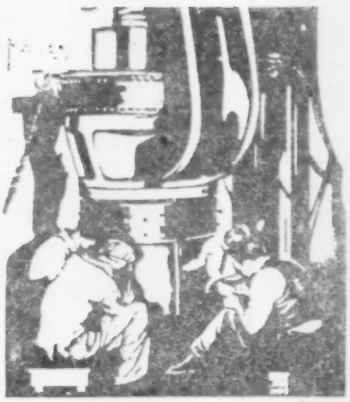
In the active field of low-cost roads, research is closely coupled with field trial and observation. Cement, bituminous and chemical industry laboratories worked on methods of utilizing their materials for subgrade and wearing surface stabilization; the work to date has shown that the amount of stabilizer must be fitted closely to the soil characteristics and that its incorporation with the soil must be carried on with full regard for moisture condition and compaction.

Among the more fundamental laboratory researches on earth roads are photomicrographic studies of the structure and formation of soil, and the effect of moisture content and admixtures on the soil structure; investigation of the influence of surface tension by mixing soil with liquids other than water; and the permeability of soil-bentonite mixtures.

Embankments and foundations

Increase of interest in soils, and the fact that all major earthwork operations are now controlled by laboratory work, served as an active stimulus to soil research. Outstanding among the events of the year in the soil field was the consulting board investigation of the great slide at Fort Peck Dam, which led to the conclusion that the shale strata under the valley fill had failed by shearing and adoption of flatter dam slopes.

Shear-strength determinations in practice and in research turned almost wholly to the triaxial compression method in place of the direct shear test. Extensive comparative tests of soils by this method at Har-



vard showed that soils similar on visual and manual inspection may be very different in mechanical strength. Study of "undisturbed" soil sampling showed that most samples are squeezed even when not distorted, suggesting that the problem of undisturbed sampling is still unsolved.

Field observation was an important part of the year's research in soils. Foundation settlement, consolidation of clay subsoil and the swell of clay when relieved of load by excavation were under observation in building foundations and in the Chicago subway tunnels. Analyses and field experience in Boston foundation work gave support to the plan of controlling settlement in soft bottom by excavation sufficient to balance the superimposed weight. The destructive settlement of the Charity Hospital in New Orleans due to lack of load balance strengthened this conclusion.

In connection with various foundation excavations and Chicago subway construction it was shown that lateral deformation of clay soils near an excavation is caused by change of stress Observation also indicated that even soft clays often are brittle at low loads and may develop cracks through which air, water or grout can find passage.

Other work includes research on protective filters for dams and study of the relation between consolidation and preconsolidation. Similar clays were found to have closely similar consolidation characteristics, an observation that facilitates estimate of preconsolidation loads. Stress and settlement conditions in soft-ground foundations were studied at Vicksburg in connection with levee construction. Field work in soils includes observation of a number of experimental embankments by the Public Roads Administration to compare the

effect of different methods of construction, and measurement of pressure on conduits in fills as related to settlement rates at Iowa State.

Working in a parallel field, Illinois is measuring pressures, friction coefficients and orifice flow of grains, in model and full-size bins.

Improvement of railroad roadbed by penetration treatment of ballast with asphalt was put to practical trial; results have not yet been reported.

Shore action being investigated

Active research in shore action and shore protection got under way in the new wave tank of the Beach Erosion Board. Submerged breakwaters to reduce wave effect were found to have a promising action, the rectangular section proving most effective. Uprush of waves and other details of wave action are also being investigated, with the aid of profile-recording instruments designed for the purpose. Field studies include a continuing survey of jetties and associated short-protection structures.

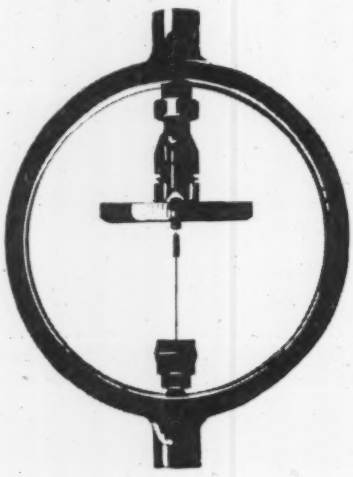
At Vicksburg, beside model tests of specific river structures, a model study of wave pressure against breakwaters is in progress, using oscillograph recording.

Work in hydraulics

Much fundamental study of water flow and essentials of hydraulic action was carried out. Special interest centered on loss of energy and transportation of sediment in turbulent flow. Energy conversion in expanding conduits is under study. At Illinois, turbulent flow of thin sludges also received attention. Small-radius bends of expanding section were developed experimentally by the Bureau of Reclamation for low energy loss. Methods of reducing wave height in rapid flow in curving channels were studied at Cal Tech, and bed material movement at Minnesota and elsewhere.

Hydraulics of flow into wells is being investigated. The Bureau of Standards studied the transmission of flood waves in rivers, density currents and stratified flow, flow in pipe coils and nozzles, and the salt-dilution method of measuring flow.

Applied hydraulic research was even more extensive. It included a large series of model tests of river and harbor sections required to serve current projects, mainly at Vicksburg. Spillways and similar structures were check-tested at numerous laboratories by model tests. Study of backflow prevention in plumbing fixtures was carried on at the Bureau of Standards by cooperation of four



manufacturers' associations. The Soil Conservation Service measured silt transportation in an actual river, while the phenomena of such transportation were investigated at Iowa City and elsewhere. A siphon of high discharge rate having Venturi outlets was developed experimentally for Mississippi River work.

Flow through locks was studied and a Tainter lock gate opening downward was tried out. Extensive comparative tests of fishways at Iowa City led to the conclusion that a modified Denil fishway is best. Stilling-pool model tests by the Bureau of Reclamation indicated that the slope of the spillway apron can be adjusted to assist in stabilizing the jump. Stilling-pool forms and flow-retarding entrance channels for the Delaware Aqueduct were worked out at Worcester.

Model tests also were used to work out forms of discharge outlets to prevent cavitation, to develop impellers for the large Grand Coulee pumps, to select inlet and draft-tube forms having best flow-distribution and lowest loss, to proportion energy-dissipating chambers where high-head discharge enters a flow-line conduit, and to work out the design of a penstock relief valve with impinging cone-jet dissipator.

Of related character as engineering investigations were the Los Angeles city tests of water hammer, which showed that slower valve closure is desirable. Development of new cast-iron pipe standards also was prominent among the year's results of test research.

General

Virtually all civil engineering laboratories throughout the country, as well as all important public construction agencies and most of the industries affiliated with construction, shared in the year's research work. Societies also made material contributions. Engineering Foundation gave valuable financial assistance to a number of researches. The American Society of Civil Engineers and the American Society for Testing Materials were influential in fostering research through their various technical committees.

The part played by industries and industrial associations is reflected not only in elaborate investigations such as those at the New Kensington laboratory of the Aluminum Company of America and the Chicago laboratory of the Portland Cement Association but also in their cooperation with college laboratories and with the Bureau of Standards in working out particular problems of materials, treatments or processes. This cooperation seems to be increasing. Industry also is the main support of the extensive research involved in the development, perfection or verification of acceptance test procedures and specifications.

An index of one phase of research progress may be found in standardization, which rests on research findings jointly with experience. Standardization was unusually active during the past year. Both the American Society for Testing Materials and the American Standards Association promulgated a large number of and variety of new standards. The A.S.A. approvals alone totaled 64.

Future research, it may be noted, will have the benefit of an unusually large testing machine, installed at New Kensington, with a capacity of 3,000,000 lb. in compression and 1,000,000 lb. in tension, and a maximum speed of 36 in. per min. Aside from new mechanical aids, however, research promises to gain further through the present high development of model testing and through the increasing recognition now given to research as an essential element in all major construction undertakings.

Advance in Field Practice

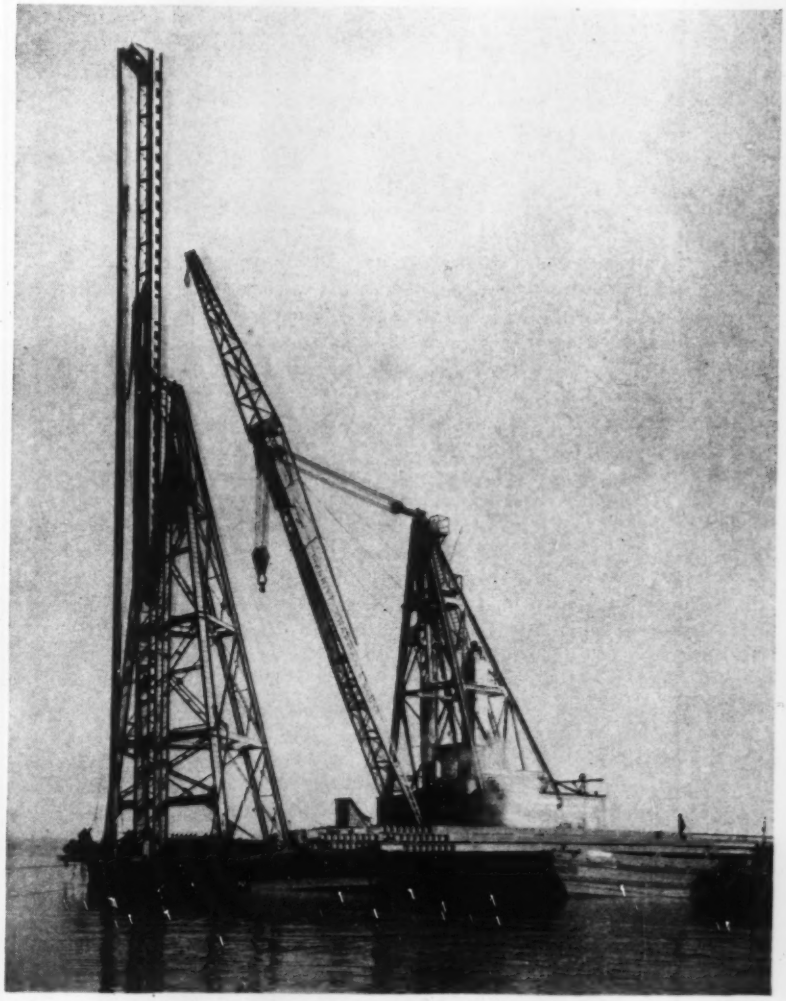
HAROLD W. RICHARDSON

WE ARE BUILDING better than ever, for a steady advance in construction technique was maintained during 1939. In some cases the operations were spectacular, even bold, illustrated by such examples as the high-speed grading and paving on the Pennsylvania Turnpike, the high cableway tower and long aggregate belt conveyor at Shasta Dam, the record-length steel piles and four-cylinder caisson sinking on the Potomac River Bridge, the elliptical thin-shell concrete domes at Hibbing, Minn., and the hydraulic filling of firm materials for the Washington airport runways. Projects such as these provide the peaks in construction advance, but the valleys between the peaks of construction achievement are filled in by contributions from the routine, ordinary jobs, which, though neither spectacular nor impressive, add up day after day into significant progress.

A notable development for these ordinary jobs and for small operations on large jobs is the extended use of small power tools. The list is impressive: winches, drills, vibrators, saws, hammers, cutters, grinders, jacks and half-a-dozen special-purpose devices now simplify and shorten the time of construction operations. Only a few of these tools are developments of 1939 but their general use became more firmly established, indeed almost a standard practice, in 1939. Many of all these types of tools are power operated, commonly by electric motors, so that electricity has become a more widely accepted power need on the ordinary job.

During the year electrical manufacturers have developed more intensively the equipment for serving the ordinary as well as the large construction operation with electric power. Transformer, motor-generator and diesel or gasoline-engine generator sets, all portable and some of them truck-mounted, have become available for the small operation. With job power supply made easy, motors have been developed for all working conditions.

As in former years, the 1939 construction improvements have come from both the individual efforts and the cooperation of all three major branches of the industry—engineers, contractors and manufacturers. The engineers continually demand higher standards of construction performance and higher quality in the finished product, endeavor to obtain more value for the investment in construction, and seek to make economically possible those projects formerly regarded as financially impossible. The contractor, faced with mounting labor costs and the demands for better quality, must work faster and more efficiently. He accepts the challenge of jobs without precedent by devising ways and means for making their construction economically feasible. He meets fierce price competition by skillful organization of the job, by clever construction methods that cut corners without sacrificing quality, and by taking advantage of the latest developments in equipment. The manufacturers contribute to the advance in construction by constant



Driving 194-ft. steel piles for the Potomac River Bridge at Ludlow Ferry, Md., using a driving rig built specially for the job.

improvement in their products, resulting in faster and more precise operation, and by wider use of alloys and high-grade bearings, resulting in longer life and lower maintenance costs.

Unusual foundation jobs

The three-party contribution to construction progress as outlined above is illustrated in many of the outstanding projects of 1939. Foundations for the Potomac River bridge at Ludlow Ferry, Md., are a good example. Here was a potential project that would be economically feasible only if suitable foundations could be built at reasonable cost. The engineers determined that steel H-section piles up to 194 ft. long, carrying two and four-cylinder caissons at river bed, would meet the foundation problem. They suggested a method of construction and specified that the piles be driven with a steam hammer far beyond the capacity of any previously built. The contractor followed the general suggestions as to construction methods, improved upon them, decided to put air on the heavier caissons for floating to place and sinking, built a great floating piledriver and ordered two hammers of the specified capacity. The manufacturer accepted the unprecedented order without hesitation, designed and built two hammers that are more than meeting expectations. The foundations proved to be one of the outstanding construction projects of the year.

Last year saw may other outstanding achievements in bridge construction. At Seattle, the novel concrete pontoons for the Lake Washington Bridge were successfully cast within a graving dock. A few miles away drop-bottom caissons were sunk in the heavy tidal flow of Puget Sound for the Tacoma Narrows bridge and were anchored to concrete blocks tipped from barges to place in the deep water. On the Mississippi River bridge at Baton Rouge long cantilever spans were erected without falsework through use of an ingenious outrigger frame at the piers. Further upstream, deep piers for bridges at Natchez and Greenville were built without cofferdams, as concrete caissons were sunk by plant carried on pipe-pile staging. In Cleveland 30-in. steel cylinders were driven 150 ft. to rock as foundations for several bridges on the relocation of the Cuyahoga River.

In building construction outstanding performances included the completion of the 11-acre Glen Martin aircraft plant in Baltimore in eleven weeks. Housing projects, such as the Commodore Perry in Buffalo and Parkchester in New York, furnished examples of high-speed coordination of construction operations. On the Red Hook and Queensbridge projects in New York and the Census Building in Washington, contractors speeded up concrete floor construction by the use of vacuum mats. Drilling foundation wells with a clay auger for the Montgomery Ward building is the latest development in building foundation construction in Chicago. Six months from foundation to roof was the impressive record made in putting up the new Federal office building in Kansas City.

Highway construction reached the peak of achievement on the Pennsylvania Turnpike. Heavy grading methods formerly known only to large earth-dam construction were applied to high-speed moving of millions of yards of material. Two general methods of earthmoving—carrying-scraper operations, and shovel excavation with motor wagon haul—were developed to new highs in efficiency. Dual-drum pavers set new records in laying concrete slab, and new screeding and finishing equipment and methods were developed to maintain the pace set by the mixers.

Other notable earthmoving projects include the Washington airport where trenches were dredged through marshland silt and backfilled with sand and gravel pumped from the river bed by hydraulic dredges for runway foundations. At Hansen Dam in California high-speed haul of scrapers with a new type of tractor and truck loading by a dragline belt-conveyor unit were new applications in dirt-moving equipment.

High-speed tunneling

The year 1939 was a notable one in tunneling. An all-time record for single-heading driving in untimbered hard rock was established on the Carlton drainage tunnel in Colorado when 1,534 ft. advance was made in one month. Exceptional progress was made in driving both timbered and untimbered sections of the Delaware River Aqueduct tunnels. A shield-driven water tunnel in Boston set a fast pace for iron-lined tunnels. Faster progress than ever before was made in some of the liner-plate sections of the Chicago subway tunnels. Of more lasting importance than speed records are new developments in tunnel driving. One of the most significant is the adoption of diesel equipment for underground work in several large tunnel projects including the Manhattan approach to the Queens-Midtown tunnel, the Merriman Dam diversion tunnel, and the seven big highway tunnels on the Pennsylvania Turnpike. The Delaware Aqueduct presents new conceptions of tunnel ventilation and dust control. The Queens-Midtown tunnel was successfully holed through after one of the most trying battles in tunneling history against mixed ground in a subaqueous compressed-air tunnel. Pumping concrete lining from a traveling mixer within the tunnel was an achievement on the Baltimore water supply project.

Concrete handling

Several concrete dams furnished examples of new and improved construction technique. At Shasta Dam a 460-ft. steel headtower is being erected to serve seven cableways, some as long as 3,000 ft., for placing the concrete. Even bolder is the decision to transport all aggregates for the big structure over 9.6 miles of belt conveyor. The difficult conditions imposed on the contractor at Ross Dam on the Skagit River by lack of space in the narrow gorge were met by installing a remote-control cableway and suspension bridges for aggregate conveyors and trucks. Grand Coulee's imposing concrete plant, with railroad haul on trestle and cantilever crane placement, turned out new records in daily yardage. Traveling high-frame gantry whirley cranes met the problem of flexible, high-speed concrete placing equipment at Pensacola Dam.

Miscellaneous items of exceptional construction interest noted during the past year include the sinking of a lake steamer as a construction breakwater for building the Toledo waterworks intake; special form construction for thin-shell concrete elliptical domes at Hibbing, Minn.; the double-hinged skid piledriver built for driving piles at any angle at the Alameda Naval Base; freezing the ground for sinking a big exploration shaft at Gilbertsville Dam, and the manufacture of 150-in. pipe in 16-ft. lengths for the Boston water supply.

CONSTRUCTION FACTS & STATISTICS

Engineering construction in 1939 [illegible] with [illegible] highway construction, water supply, sewage disposal and public buildings. Steady costs and [illegible] set the pace for 1939. The full measure of construction's [illegible] are set forth in the following [illegible]

Construction Volume

Construction Financing

Construction Employment

Construction Material Shipments

Construction Costs

Construction Wages Paid

Construction Man-Hours Worked

Construction Gains Again

AGAIN, for the sixth time in a row, construction turns in an increase over the year before. The estimated total for 1939 is $6,974,000,000—including residential building as well as all types of engineering construction of all sizes. This is 8 per cent more than for 1938.

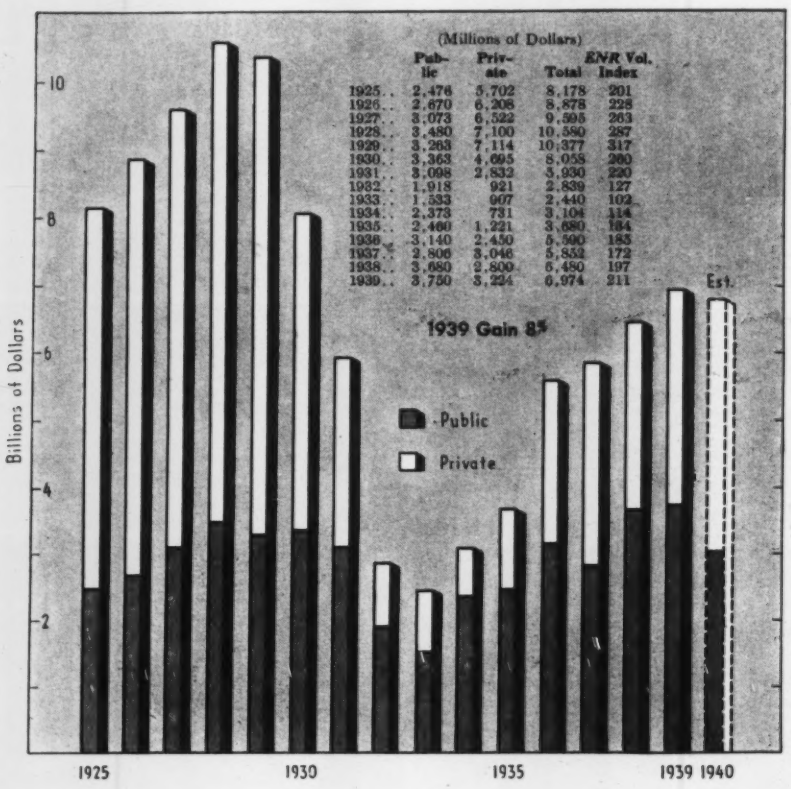
In this same period both general business and manufacturing came out of the nose dive they took in 1938. And they came out fast, with gains of 24 per cent in the *Business Week* index and 25 per cent in the Federal Reserve Board index of manufacturing.

The general business index is 76 per cent higher than in 1932, the depth of the depression, and the manufacturing index is up 67 per cent. Construction dollar volume more than doubles the 1932 average, increasing 146 per cent.

The year's construction total combines an all-time record volume of public works, $3,750,000,000, with the highest total of private engineering construction and residential building since 1930, $3,224,000,000. The public works gain is 2 per cent, all credited to state and municipal work with its 8 per cent increase since federal construction dropped 15 per cent.

The private construction estimate is 15 per cent above the 1938 total due to a 20 per cent rise in residential building, and an 11 per cent gain in private engineering work. Residential construction, estimated at $1,442,000,000, is at the highest level since 1929. Private engineering construction reflects the spurt in industrial building in the second half of the year, and exceeds (with the exception of 1937) all years since 1931.

1. ESTIMATED TOTAL—ALL CONSTRUCTION IN U. S.

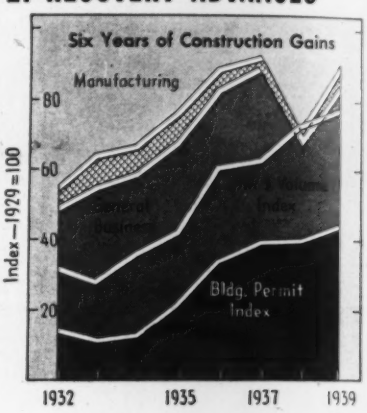


	Public	Private	Total	*ENR* Vol. Index
1925	2,476	5,702	8,178	201
1926	2,670	6,208	8,878	228
1927	3,073	6,522	9,595	263
1928	3,480	7,100	10,580	287
1929	3,263	7,114	10,377	317
1930	3,363	4,695	8,058	260
1931	3,098	2,832	5,930	220
1932	1,918	921	2,839	127
1933	1,533	907	2,440	102
1934	2,373	731	3,104	114
1935	2,460	1,221	3,680	134
1936	3,140	2,450	5,590	183
1937	2,806	3,046	5,852	172
1938	3,680	2,800	6,480	197
1939	3,750	3,224	6,974	211

Building permits

Building permits reported gains range from 8 per cent by Dun & Bradstreet for 215 cities to 13 per cent by Commercial and Financial Chronicle for 354 cities to 24 per cent by the Bureau of Labor Statistics for 257 identical cities. Outside of New York City the gain for building permits is 28 per cent. New York City shows a 35 per cent decline, which reduces the average for the Middle Atlantic district to 23 per cent, the only area for which Dun & Bradstreet reports a loss. The Pacific region shows the smallest gain, 9.6 per cent, East Central the largest, 46 per cent.

2. RECOVERY ADVANCES



The *ENR* Construction Volume Index based on dollar volume adjusted for cost changes to measure physical volume averages 211 for the year, a 7 per cent gain. The index is reported in Table I at the left, together with the totals of private and public construction since 1925.

Construction financing

Construction financing recorded by *Engineering News-Record* totalled $2,405,000,000 for 1939, a drop of 35 per cent below the previous year. This recorded total includes USHA loans to municipal housing authorities, federal aid to states for highways, investment by private capital in state and municipal construction

bonds and in corporate construction securities, government loans to industry for construction and rural electrification loans. Another block of $915,000,000 of construction money comes from gasoline and other motor vehicle taxes. Gasoline tax money increased available highway funds in 1939. Cost of money dropped during the year for all classes of bonds and for municipal financing established a new all time low.

Construction costs averaged 0.2 per cent lower than for 1938. They closed 1939 1.5 per cent higher, however, than at the outset of the year. Labor rates were slightly above a year ago. Lumber also advanced. Steel dipped from its 1938 average price, while cement remained unchanged.

Outlook for 1940

The rising volume of private construction sets the construction pattern for 1940. A moderate increase in small residential building and a substantial gain for industrial building led by the utilities should put private construction in the lead with a 17 per cent volume increase estimated for the year ahead.

The amount of public work, on the other hand, can hardly be expected to duplicate the record volume stimulated by PWA financing. While state highway budgets for highways and bridges indicate a 6 per cent increase over 1939, federal and municipal construction will probably pull the public total down about 19 per cent below the 1939 record. This means an estimated total volume of construction for 1940 approximately 2 per cent under 1939, or a construction budget of $6,800,000,000 for the new year.

Construction costs begin the year with few fluctuations from the values at the close of 1939, which in itself was a year of stable costs.

It is too early to detect what the effect will be on construction costs of the anti-trust drive by Assistant Attorney-General Thurman Arnold, or the effect of war buying later in the year. The immediate outlook is for continuing levels.

The detailed report follows, an account of how construction expenditures have been distributed, how financed, of how construction has been manned and supplied, and of how costs of construction material and labor compare with previous years.

Engineering Construction Sets New Records

Engineering News-Record recorded 19,000 new construction projects in 1939 with capital expenditures totalling $3,002,856,000. An increase of 8 per cent over 1938, this is the highest engineering construction volume since 1930. Contributing to this total, public work reached $2,112,149,000, the highest public volume ever recorded and a 6 per cent gain over a year ago. Private awards, $890,707,000, topped 1938 by 11 per cent and exceeded, with the exception of 1937 when they totalled $1,115,866,000, all years since 1931.

Contractor-built projects

The above number of jobs is the largest since 1930, an increase of 5 per cent over 1938. Contractor-built projects just held their own, however, 13,639 in 1939 compared with 13,659 in 1938 while day labor or separate-contracts projects increased 23 per cent, from 4,407 to 5,405. The number of contractors reported gained 7 per cent, from 5,817 to 6,233. These contractor-projects statistics are reported in more detail on the Construction Trends page in this issue.

Per capita construction

Per capita engineering construction (Table II) averaged $24.45 for the nation as a whole. Public works accounted for $17.19 of this total, and the balance, $7.26, was for private work. As was to be expected, wide differences exist between national and sectional per capita averages. Middle Atlantic reported $34.18 per person, and Far West, $32.10, both above the national average. New England and West of Mississippi each spent $21.43 per capita; Middle West $21.21; and South, $17.83.

The public works expenditures per person ranged from $25.40 in Far West to $13.58 in the South. Private construction spending was the largest in Middle Atlantic, $11.83, and the smallest in the South, $4.25.

By class of work, more engineering construction money was spent on highways than on any other type of construction, $5.23 per capita. Public buildings were next, $4.82, followed by unclassified, $3.17; commercial building and large-scale private housing, $3.16; industrial buildings, $2.31; and earthwork and drainage, $1.90. Waterworks, sewerage and bridge expenditures were $1.33, $1.30 and $1.17 per person, in that order.

II ENGINEERING CONSTRUCTION PER CAPITA

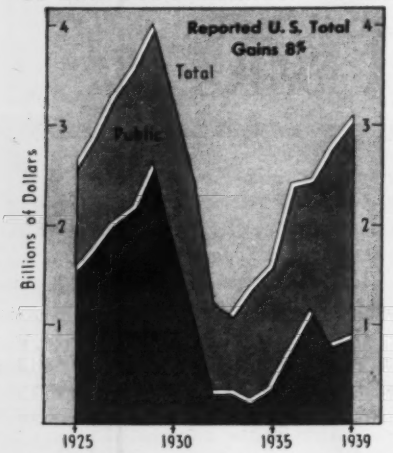
(*E N R* Reports)

Class of work	New England	Middle Atlantic	South	Middle West	West of Miss.	Far West	U. S. Aver.
Waterworks	$1.56	$3.02	$0.41	$0.97	$0.72	$1.10	$1.33
Sewerage	1.61	1.72	.34	1.92	1.12	1.16	1.30
Bridges, Public	1.09	1.45	1.00	1.01	.83	2.12	1.17
Earthwork	1.59	1.02	2.48	.42	1.76	7.43	1.90
Highways	2.21	6.53	3.47	4.88	6.81	5.46	5.23
Public Bldgs	5.19	6.79	4.76	3.89	3.38	5.16	4.82
Industrial Bldgs	2.22	3.27	1.98	2.50	1.54	1.88	2.31
Commercial Bldgs	4.84	7.24	1.06	2.21	1.08	3.13	3.16
Unclassified	1.08	3.03	2.33	3.39	4.13	4.56	3.17
Total Public	$13.87	$22.35	$13.58	$14.55	$15.65	$25.40	$17.19
Total Private	7.56	11.83	4.25	6.66	5.78	6.70	7.26
Grand Total	**$21.43**	**$34.18**	**$17.83**	**$21.21**	**$21.43**	**$32.10**	**$24.45**

New record for the South

The eleven Southern states reported, in 1939, their largest total construction volume on record, $454,000,000, a gain of 51 per cent above the preceding year and 15 per cent of the total for the whole country. Middle West and West of Mississippi exceeded all yearly totals since 1929 with $536,000,000 and $549,000,000, respectively, 40 and 10 per cent increases over 1938 and each approximately 18 per cent of the national total. New England construction, 18 per cent above 1938 established an 8-year record and with $175,000,000 accounted for 6 per cent of the U. S.

3. ENR CONSTRUCTION TOTAL



total. Middle Atlantic dropped 7 per cent under 1938 to $978,000,000 and Far West 24 per cent below its all-time high of a year ago to $310,000,000. These make up 33 and 10 per cent, respectively, of the national total.

New records by types

Four classes of construction broke their all-time volume records in 1939. Streets and roads with expenditures of $644,000,000 were 1 per cent above their record for last year. This record was due to heavy municipal and special highway construction including the Pennsylvania Turnpike since state highway expenditures were 2 per cent lower than in 1938. This recorded highway volume represents 21 per cent of the total engineering construction of all types.

Public buildings eclipsed their previous high of 1938 by 18 per cent with a total volume of $593,000,000, 20 per cent of the overall construction total. Public housing accounted for $178,543,000 of this public building total, or 30 per cent.

Waterworks at $163,000,000 and sewerage at $160,000,000 surpassed their records of a year ago by 24 and 17 per cent and accounted for 5.4 and 5.3 per cent of the volume of all classes.

Bridge construction with the second highest volume ever reported, $150,631,000, topped last year by 12 per cent and produced 5 per cent of the total engineering construction. Unclassified construction rose to the highest level since 1930, 40 per cent above 1938 with a total of $390,000,000, 13 per cent of the total volume of all classes of construction. Earthwork and drainage fell 13 per cent to $233,000,000, 8 per cent of the U. S. total for all classes.

Private buildings

Commercial building and large-scale private housing produced 13

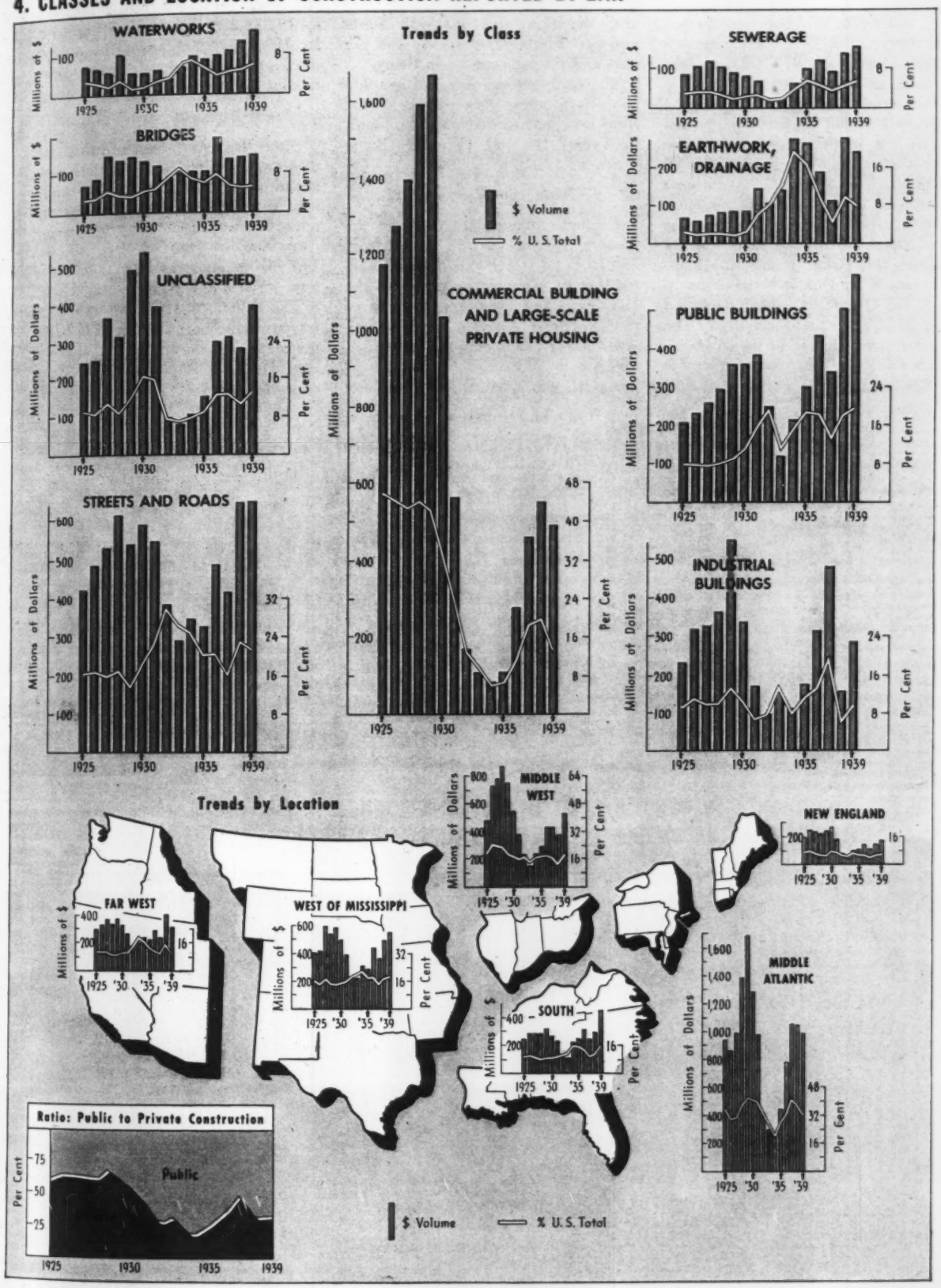
III—ENGINEERING CONSTRUCTION REPORTED IN 1939 BY *ENR*

(Thousands of Dollars)

Minimum contracts reported: Waterworks, excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

States	BUILDINGS									Federal Gov't Work	All Construction		1939 Total	1938 Total	% Gain '39/'38
	Waterworks	Sewers	Bridges	Earthwork	Streets and Roads	Industrial	Commercial	Public	Unclassified		Private	Public			
Me.	184	25	1,999	.....	1,861	287	550	1,179	235	434	1,072	5,248	6,320	7,412	−15.0
N. H.	123	277	1,187	5,156	1,739	90	200	1,563	665	6,249	792	10,208	11,000	6,978	58.0
Vt.	8	.....	1,775	.....	1,013	90	775	595	49	24	911	3,394	4,305	3,206	34.0
Mass.	9,719	7,015	1,384	3,685	4,597	7,856	13,928	22,839	2,351	7,336	22,322	51,052	73,374	65,485	12.0
R. I.	1,657	1,868	495	1,478	989	918	2,851	1,256	2,198	2,389	4,185	9,525	13,710	10,917	25.5
Conn.	1,080	3,975	2,381	2,611	7,830	8,851	21,247	14,978	3,317	3,133	32,393	33,877	66,270	54,927	21.0
New Eng.	**12,771**	**13,160**	**9,221**	**12,930**	**18,029**	**18,092**	**39,551**	**42,410**	**8,815**	**19,565**	**61,675**	**113,304**	**174,979**	**148,925**	**18.0**
N. Y.	74,571	26,110	25,619	8,541	58,298	12,475	164,910	96,411	54,728	11,895	204,389	317,274	521,663	695,199	−25.0
N. J.	3,480	9,421	9,828	6,248	45,078	32,129	20,593	32,107	11,407	6,224	54,850	115,441	170,291	140,257	21.5
Pa.	7,656	7,839	3,259	9,554	75,057	29,689	9,618	26,330	13,315	13,782	47,121	135,196	182,317	161,008	13.0
Md.	527	5,832	6,727	4,504	7,215	10,328	11,149	39,095	7,158	30,192	23,226	69,309	92,535	50,777	82.0
Del.	22	147	152	292	959	9,000	905	105	14	505	9,905	1,691	11,596	5,918	96.0
Mid. Atl.	**86,256**	**49,349**	**45,585**	**29,139**	**186,607**	**93,621**	**207,175**	**194,048**	**86,622**	**62,598**	**339,491**	**638,911**	**978,402**	**1,053,159**	**−7.0**
Va.	234	673	3,560	1,002	10,930	2,610	1,325	11,007	2,569	8,620	5,641	28,275	33,916	34,468	−2.0
W. Va.	23	225	1,041	2,303	6,227	10,695	.....	5,514	1,095	2,533	10,790	16,333	27,123	14,094	92.0
N. C.	2,178	2,658	1,674	1,029	18,370	15,723	3,581	13,163	9,058	5,091	21,855	45,579	67,434	41,552	62.0
S. C.	1,144	1,672	1,126	23,282	3,250	640	1,060	4,596	4,137	10,431	2,869	38,038	40,907	19,854	106.0
Ga.	1,556	378	1,540	695	4,880	5,456	4,166	16,483	6,525	1,610	15,960	25,719	41,679	28,727	45.0
Fla.	1,940	1,439	1,565	5,351	9,099	3,495	16,472	12,894	12,414	13,121	16,472	42,247	58,719	24,621	138.0
Ala.	321	126	497	591	5,309	9,818	1,498	10,517	8,263	2,187	15,775	21,165	36,940	18,492	100.0
Miss.	307	.....	7,313	1,749	18,120	40	313	3,581	3,268	2,442	3,484	31,207	34,691	23,898	45.0
La.	322	521	2,571	5,885	2,212	584	2,840	22,574	3,356	10,551	6,182	34,683	40,865	29,432	39.0
Ky.	2,262	968	3,649	13,045	6,200	190	735	7,891	5,396	14,003	6,166	34,170	40,336	30,887	30.0
Tenn.	290	97	1,226	8,115	3,800	1,182	1,015	12,536	3,085	8,639	3,298	28,348	31,646	34,374	−8.0
South.	**10,577**	**8,757**	**25,768**	**63,047**	**88,397**	**50,433**	**27,055**	**121,056**	**59,166**	**79,228**	**108,492**	**345,764**	**454,256**	**300,399**	**51.0**
Ohio	9,815	13,276	10,265	2,047	53,835	16,855	16,048	28,917	16,417	2,396	43,186	124,289	167,475	119,536	40.0
Ind.	825	13,887	2,348	1,544	23,437	8,332	3,740	10,142	11,097	2,287	20,455	54,897	75,352	47,770	58.0
Ill.	7,063	7,781	8,685	3,971	25,487	24,272	26,839	35,574	50,766	12,915	76,620	113,818	190,438	128,583	48.0
Wis.	1,392	9,022	2,010	654	10,079	10,456	3,798	7,290	3,433	939	17,317	30,817	48,134	38,800	24.0
Mich.	5,308	4,704	2,717	2,306	10,761	3,033	5,528	16,353	4,017	2,854	10,823	44,204	55,027	47,603	16.0
Mid. West.	**24,403**	**48,670**	**26,025**	**10,522**	**123,599**	**63,248**	**55,953**	**98,276**	**85,730**	**21,391**	**168,401**	**368,025**	**536,426**	**382,292**	**40.0**
Minn.	667	5,876	1,164	593	9,245	6,472	3,451	8,991	14,061	861	23,459	27,061	50,520	29,925	69.0
Iowa	981	2,852	3,570	2,567	12,674	4,007	2,198	7,916	20,440	2,063	25,849	31,356	57,205	49,578	15.0
Mo.	798	6,453	4,119	3,355	15,396	3,635	8,092	7,904	12,126	5,256	21,961	39,917	61,878	74,094	−17.0
Ark.	187	145	751	4,213	4,155	969	.....	2,780	3,143	3,994	3,960	12,383	16,343	13,222	24.0
N. D.	577	292	536	78	5,726	50	.....	806	1,776	507	1,319	8,522	9,841	8,191	20.0
S. D.	72	299	219	2,590	3,659	.....	.....	2,718	231	342	94	9,694	9,788	6,759	45.0
Neb.	1,197	2,916	475	3,129	12,608	575	1,435	7,853	12,495	1,869	9,799	32,884	42,683	38,007	12.0
Kan.	4,274	318	1,084	1,160	5,404	1,310	500	5,775	3,101	1,504	4,588	18,338	22,926	35,441	−35.0
Okla.	1,202	1,653	2,615	4,615	23,287	1,123	.....	2,468	5,825	4,676	4,071	38,717	42,788	63,944	−33.0
Tex.	7,579	6,820	6,935	15,688	56,512	17,742	11,108	23,473	22,349	18,554	41,868	126,338	168,206	121,143	39.0
Mont.	194	340	7	4,161	9,527	40	.....	3,214	1,738	3,964	1,225	17,996	19,221	12,857	50.0
Wyo.	319	64	205	1,223	5,050	40	.....	2,550	2,886	2,663	2,329	10,008	12,337	11,727	5.0
Colo.	164	320	828	1,478	6,942	9	1,000	9,569	5,039	8,918	3,723	21,626	25,349	22,844	11.0
N. M.	99	309	125	190	4,320	3,500	.....	738	246	635	3,683	5,844	9,527	9,620	−1.0
W. of Miss.	**18,310**	**28,657**	**22,633**	**45,040**	**174,505**	**39,472**	**27,784**	**86,755**	**105,456**	**55,806**	**147,928**	**400,684**	**548,612**	**497,352**	**10.0**
Idaho	224	270	60	376	1,924	631	300	876	1,411	1,973	1,694	4,378	6,072	7,829	−22.0
Utah	888	1,468	79	1,096	3,902	550	623	2,235	3,089	1,439	3,685	10,245	13,930	17,616	−21.0
Ariz.	582	120	403	4,579	4,272	.....	1,042	1,288	915	5,486	1,667	11,534	13,201	16,250	−19.0
Nev.	.....	.....	77	1,442	2,334	114	90	2,292	2	3,091	204	6,147	6,351	5,522	15.0
Wash.	4,065	1,307	9,493	16,965	17,151	4,046	2,638	6,714	14,872	31,037	9,805	67,443	77,251	139,909	−45.0
Ore.	517	279	1,336	5,266	9,201	1,084	1,805	2,817	5,390	11,236	3,882	23,813	27,695	37,444	−26.0
Calif.	4,328	7,785	9,951	42,188	13,850	11,689	23,763	33,739	18,388	60,460	43,780	121,901	165,681	185,234	−11.0
Far West	**10,604**	**11,229**	**21,399**	**71,912**	**52,634**	**18,114**	**30,261**	**49,961**	**44,067**	**114,722**	**64,720**	**245,461**	**310,181**	**409,804**	**−24.0**
U. S. 1939	**162,921**	**159,822**	**150,631**	**232,590**	**643,771**	**282,980**	**387,779**	**502,506**	**389,856**	**353,310**	**890,707**	**2,112,149**	**3,002,856**	.....	.....
U. S. 1938	131,209	136,075	134,633	268,306	637,862	152,098	549,746	503,000	279,002	367,784	880,756	1,991,175	.....	2,791,931	.....
% Gain '39/'38	24.0	17.0	12.0	−13.0	1.0	86.0	−29.0	18.0	40.0	−4.0	11.0	6.0	.....	.....	8.0
Canada '39	6,954	2,230	3,033	6,555	33,647	20,994	12,089	10,049	17,505	.....	59,134	73,922	113,056	.....	25.0
Canada '38	3,768	3,246	5,949	11,398	14,874	12,511	10,200	11,993	16,549	.....	27,158	63,321	.....	90,479	.....

4. CLASSES AND LOCATION OF CONSTRUCTION REPORTED BY *ENR*



per cent of the engineering construction, $388,000,000, but was 29 per cent lower than 1938. Housing accounts for $273,134,000 of the amount, or 70 per cent.

Industrial buildings, following a poor start during the first half, picked up so fast in the latter part of the year that they topped 1938 by 86 per cent. The $283,000,000 volume represents 9 per cent of the engineering construction reported for the year. One-third of this total was for utilities and power plants, the highest volume in this industrial group since 1929. Aircraft factories totalled $11,037,000, an all-time high. The process industries at $78,000,000 increased 21 per cent, food industries at $24,000,000, 16 per cent. Metal refining and rolling at $22,000,000 and machine and machine parts plants at $14,000,000 are up 156 per cent and 63 per cent respectively.

The complete tabular and graphic analysis of these *Engineering News-Record* volume statistics will be found in Tables III and IV, and Charts 3 and 4.

Concrete yardage

Concrete pavement yardage decreased 10 per cent in 1939, from 55,216,772 to 49,826,925 sq.yd., according to preliminary report of the Highways and Municipal Bureau of the Portland Cement Association. Awards for roads dropped from 36,900,856 to 29,726,526 sq.yds., or 19 per cent, while pavement for streets and alleys increased from 18,315,916 to 19,214,396 sq.yd. or 5 per cent. In 1939, 886,003 sq.yd. of airport pavement was reported, a new classification for these statistics.

State highway construction

State highway expenditures for new construction in 1939 were estimated at $486,000,000 by state highway engineers reporting for the annual highway issue of *Engineering News-Record*, Jan. 18, 1940, p. 94, and maintenance at $233,000,000, a total of $719,000,000 compared with $735,000,000 in 1938, $493,000,000 for construction and $242,000,000 for maintenance. If Florida (not included above) duplicates 1939, road expenditures will increase in 1940

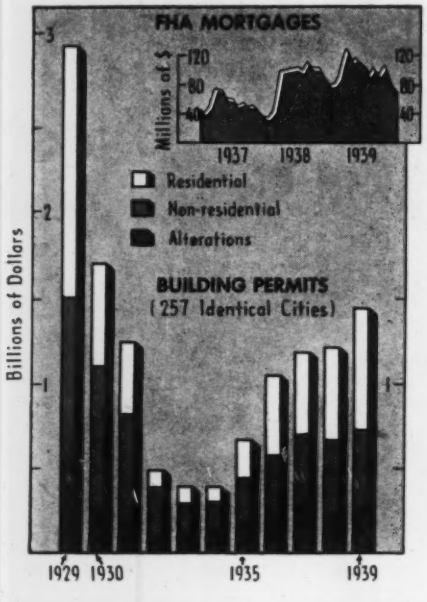
IV — CONTRACTS FOR INDUSTRIAL BUILDING CONSTRUCTION BY INDUSTRIES

(Value in Thousands of Dollars ENR Reports)

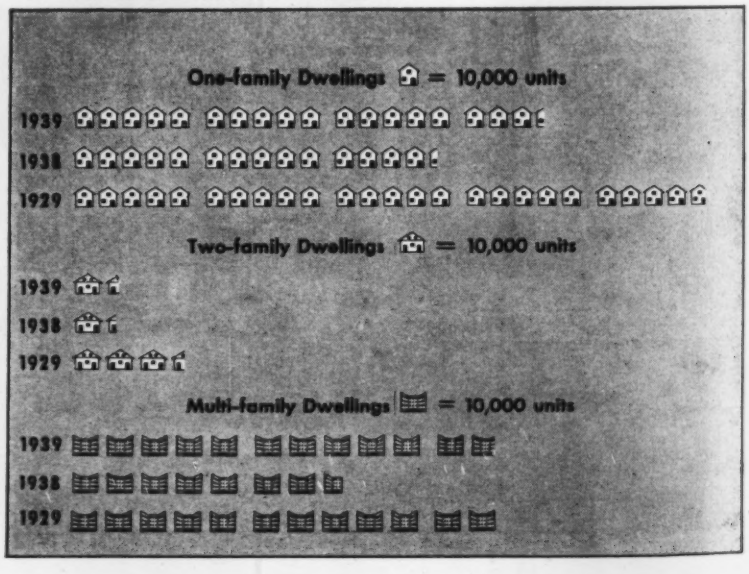
Transportation Service	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939 No.	1939 Value
1. Railroads	.....	.....	.....	.....	.....	.....	$1,108	$3,621	$909	$712	$1,690	$2,417	$2,546	17	$1,447
2. Automotive	$29,029	$23,022	$37,181	$28,962	$18,090	$10,479	9,562	10,288	5,655	4,173	5,127	8,431	4,2s0	61	4,114
Public Utilities and Other Power Plants	91 621	43,860	64,273	151,033	86,137	40,813	22,800	14,290	1,741	7,577	42,481	70,765	37 6s8	59	94,822
Process Industries (a)	38 499	67,415	82,391	122,048	52,741	24,679	19,002	43,203	21 922	34,655	81,627	111,246	45,5?9	302	78,239
Food Industries (b)	22,0"0	30,827	32,957	32,138	21,289	14,311	14,385	50,038	20,6"4	19,655	28,639	36,248	13,838	280	23,049
Metal Refining and Rolling	6,180	26,847	19,014	48,920	34,083	3,515	745	6,979	31,609	59,075	65,505	111,426	8,590	33	22,340
Metal Working Plants															
1. Auto Factories*	.....	.....	.....	.....	6,380	3,120	3,735	331	1,709	3,553	17,410	21,763	2,665	9	1,562
2. Aircraft Factories	.....	211	4,361	14,818	2,230	75	418	128	30	425	915	4,312	590	36	11,037
3. Foundries	3,442	2,852	4,752	4,150	2,146	1,686	188	465	368	1,952	1,541	1,890	335	17	1,819
4. Machine and Machined Parts (c)	65,132	6,985	11,503	17,044	6,374	6,639	5,220	2,848	3,404	11,079	14,560	41,030	8,757	139	14,343
Textiles (excluding rayon)	13,280	46,134	9,103	9,705	3,300	2,427	2,047	2,781	1,431	2,216	3,421	5,017	2,039	45	3,714
Wood Industries	7,564	3,204	2,632	4,857	1,400	726	595	2,296	488	999	1,008	825	480	15	950
Miscellaneous															
1. General Factories	39,330	65,670	75,989	110,311	87 2"4	53,181	12,646	14,618	14,752	26,118	45,344	61,511	23,760	358	24,744
1. Refrigeration and Cold Storage	5,820	4,288	10,817	3,327	9,727	4,099	613	490	500	278	209	417	1,011	12	800
Total	$321,967	$321,315	$355,187	$547,313	$331,171	$165,750	$93,064	$152,376	$105,192	$172,467	$309,477	$477,298	$152,098	1,382	$282,980

* Auto factories for years 1926, 1927, 1928 and 1929 are included under "Automotive" — Transportation Service.
(a) Includes Distilleries.
(b) Includes Breweries and Wineries.
(c) Includes Radio Plants.

5. BUILDING PERMITS GAIN 24%



6. DWELLING UNITS PROVIDED



to $519,000,000 for construction, $240,000,000 for maintenance, or a total of $759,000,000 for construction and maintenance estimated for the 48 states. This is a 6 per cent increase for the coming year in the most closely budgeted branch of construction industry.

Building permits and housing

Building permits as reported by the U. S. Bureau of Labor Statistics for 257 identical cities in 1939 totalled $1,457,750,000, a 24 per cent increase over 1938 and the highest since 1930. New residential construction in those same cities was 36 per cent higher than a year ago and the highest since 1929; non-residential was up 18 per cent; and alterations and repairs topped a year ago by 4 per cent.

The trend of FHA mortgages selected for appraisal continued upward in 1939, topping the previous year by 11 per cent. In 1936 they averaged $44,900,000 per month; in 1937, $49,100,000; increased to $84,200,000 in 1938; and in 1939 reached $93,500,000 per month. A decrease of 0.5 per cent on FHA mortgage interest in the last half of the year has as yet had no appreciable effect in increasing FHA building.

It is estimated that 154,000 new dwellings were constructed in 1939 under FHA sponsorship, an increase of 30 per cent over last year. New dwelling construction made up 70 per cent of FHA mortgages selected for appraisal in the year just passed. This compares with 58 per cent in 1938.

During 1939, 343,084 dwelling units were provided in urban areas according to the final reports of the Bureau of Labor Statistics, an increase of 40 per cent over last year. One-family dwellings totalled 238,029 units, 42 per cent higher than a year ago; two-family dwellings, 17,534 units, up 26 per cent; and multi-family buildings, 87,521 units, an increase of 35 per cent over the preceding year.

In the first nine months of 1939 during which 259,336 dwelling units were constructed in urban areas, the USHA sponsored 35,127 units. A comparable 1938 figure cannot be given as it was not until July of that year that USHA projects began to reach contract stages. From July through September, 1938, 4,626 units were provided.

Construction Financing

CONSTRUCTION financing in 1939 dropped 35 per cent below a year ago. The completion of the 1938 PWA financing program coupled with an attendant decrease in state and municipal bond sales was largely responsible for the loss. Other factors were the lower volume of corporate securities and USHA loans. Federal financing for relief and departmental programs just about equalled 1938.

Another important source of money, but one not included in the *ENR* new capital statistics and chart, is from motor vehicle licenses, fuel and oil taxes which added approximately $915,000,000 to new construction capital in 1939. Appropriations from treasury funds, payments from current income and unrecorded borrowing for capital expenditures made up the balance of the nation's 1939 investment in fixed capital.

Cost of construction money fell below the levels of a year ago for industrial, public utility and railroad financing and to a new all-time low for municipal borrowing. As measured by yields of high grade bonds, the industrial financing rate in 1939 averaged 5.01 per cent compared with 5.07 per cent last year; public utility rate declined to 4.48 from 4.80 per cent in 1938; railroad rate to 7.65 from 8.37 per cent a year ago; and municipal yield rate dropped to 2.76 per cent from 2.91 per cent in 1938.

V—CORPORATE, STATE AND MUNICIPAL FINANCING

(Millions of Dollars)

	Total Financing Inc. Refunding*			New Productive Capital		
	Corporate	State and Mun.	Total	Corporate	State and Mun.	Total
1925	$4,222	$1,400	$5,622	$1,966	$1,352	$3,318
1926	4,574	1,365	5,939	1,824	1,344	3,168
1927	6,507	1,510	8,017	1,784	1,475	3,259
1928	6,930	1,425	8,345	1,568	1,379	2,947
1929	9,376	1,431	10,807	1,758	1,418	3,176
1930	4,757	1,487	6,244	2,032	1,434	3,466
1931	2,371	1,256	3,627	787	1,235	2,022
1932	643	849	1,484	159	561	720
1933	380	520	900§	292	1,091‡	1,383
1934	490	939	1,429§	77†	1,011‡	1,088
1935	2,267	1,220	3,488§	47†	1,305‡	1,352
1936	4,632	1,117	5,749§	250	698‡	948
1937	2,434	902	3,336§	518†	738‡	1,256
1938	2,139	1,100	3,239§	457†	1,902‡	2,359
1939	2,179	1,127	3,306§	304†	783‡	1,087

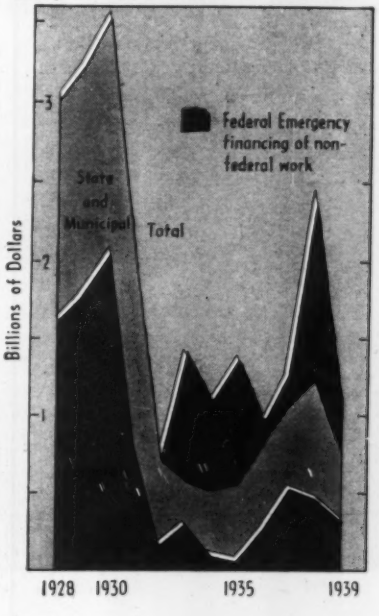
* From Commercial and Financial Chronicle.

§ PWA Financing not included.

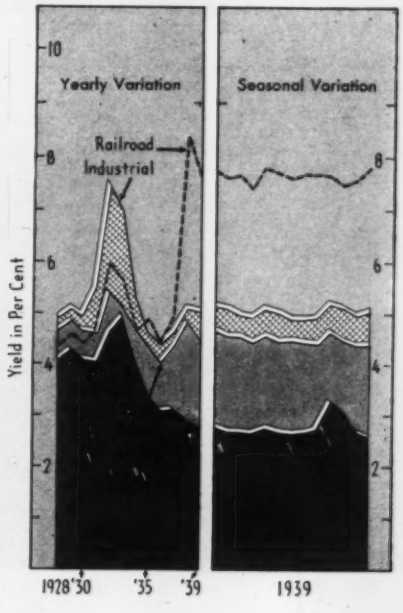
† Includes $237,000,000 RFC and PWA loans, '33; $55,000,000, '34; $9,000,000, '35; $807,000, '37; $76,106,000 REA, $4,500,000 RFC loans, '38; $89,000,000 REA and $400,000 in RFC Loans, '39.

‡ Includes $814,000,000 RFC and PWA loans and grants, '33; $580,000,000, '34; $808,000,000, '35; $164,700,000, '36; $207,000,000, '37; $723,265,000 PWA, $99,844,000 RFC, $320,986,000 USHA loans, '38; $216,000,000 in USHA loans, '39.

7. SOURCE AND VOLUME OF NEW CONSTRUCTION MONEY



8. COST OF FINANCING SHOWN BY BOND YIELDS



Employment and Materials

AN INCREASE in construction employment to 16 per cent above 1938 is estimated by the National Industrial Conference Board, with an average of 2,190,000 men at work each month compared with an average of 1,875,000 last year. Union building trade members were 72 per cent employed during the past year against 63 per cent in 1938, according to the American Federation of Labor reports. The resultant gain in building employment, 14 per cent, compares with the overall union trades gain of 6 per cent.

The upswing in construction employment began in the early spring, receiving impetus from PWA projects then in the contract stages. A fairly even trend was maintained throughout the balance of the year, the usual seasonal decline in the latter part being largely averted by the autumn spurt in private building activity.

Federal and state highway construction and maintenance employment in 1939 reflected the cuts made in federal aid appropriations for the 1939 and 1940 fiscal years by recording a drop of 17 per cent from the previous twelve-month period.

The national construction employment trends agree closely with the 14 per cent rise computed by Ohio State University for the Buckeye State.

Material shipments

Construction material shipments in general responded to three factors in 1939 that tended to increase their totals. First, the demand of public construction as a result of the PWA work in the first part of the year; second, the building up of inventories to insure reserve supplies in order not to be delayed by war orders that were expected in some markets; and third, fear of increased prices due to the war.

Wide gains were registered in some materials as a result of these influences. Lumber shipments were up 18 per cent; fabricated structural steel, 24 per cent; cement, 15 per cent; common brick, 30 per cent, and steel plate, 25 per cent.

Lumber shipments reached the highest level since 1929, and cement topped all years since 1931. Common brick shipments exceeded all annual totals for the six years for which statistics are available. Prepared roofing shipments just about equalled the 8-year record set last year, both high totals being due to the increased volume of residential construction activity so apparent during both periods.

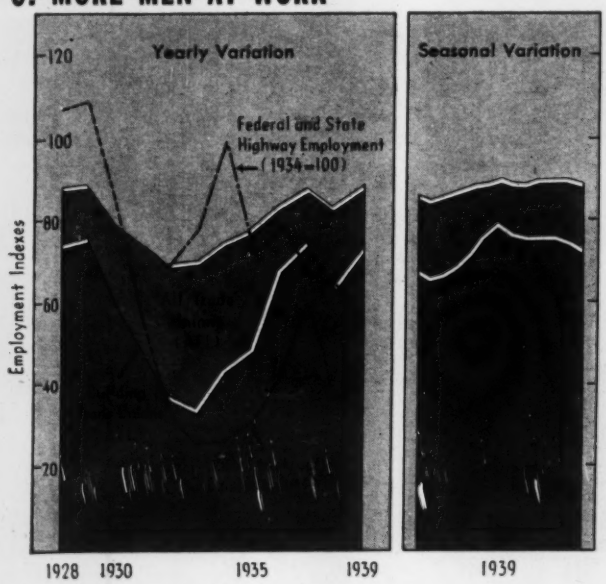
The upsurge of private construction in the last few months of 1939, and the prospects for this type of work in 1940 revealed by construction budgets of large corporations have quieted fears that the materials market would be slowed down because of heavy inventory buying.

VI — OUTPUT OF VARIOUS CONSTRUCTION MATERIALS FOR TEN YEAR PERIOD

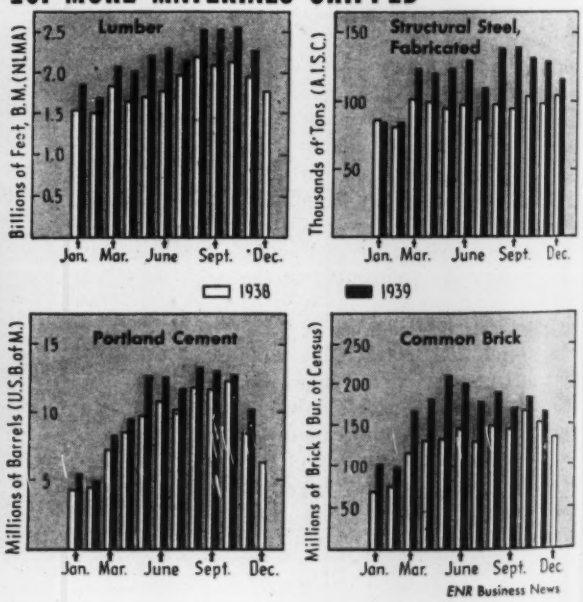
Item	Basis	Unit	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939*	% Change '38 to '39
Lumber	Production	Millions Bd. ft.	26,051	16,523	10 824	14,700	15,492	19,539	24,355	25,997	21,646	25,200	+16
Cement	Shipments	Thous. Bbl.	159,558	126,465	80,329	64,086	75,917	74,936	112,566	114,010	106,533	122,276	+15
Steel Ingots	Production	Thous. Tons	39,595	25,193	13,323	22,594	25,599	33,426	46,807	49,503	27 742	45 769	+65
Fabricated Structural Steel	Shipments	Thous. Tons	2,987	1,812	942	828	1,033	1,095	1,548	1,660	1,159	1,440	+24
Fabricated Steel Plate	New Orders	Thous. Tons	569	303	162	198	242	258	484	429	285	357	+25
Explosives	Shipments	Thous. lb.	424,920	325,440	227,508	249,366	307,380	297,730	378,361	387,805	320,259	372,470	+16
Common Brick	Shipments	Millions	.....	.....	.....	.....	637	952	1,720	1,806	1,537	1,999	+30
Vit. Paving Brick	Shipments	Thousands	.....	.....	.....	.....	87,216	62,528	96,001	79,716	84,887	70,785	−17
Prepared Roofing	Shipments	Thous. squares	27,876	22,560	23,220	24,732	24,000	26,052	32,237	29,942	34,635	34,476	0

* Estimated Totals.

9. MORE MEN AT WORK



10. MORE MATERIALS SHIPPED



ENR Business News

Construction Costs

CONSTRUCTION costs rose moderately late in 1939, but for the year averaged 0.2 per cent under 1938 as measured by *ENR* Construction Cost Index. A slight decline during the first three months of the year was followed by six months of stability. The last quarter saw a rise occasioned by increased lumber prices. Though costs were just under the 1938 average, in December they had climbed 1.5 per cent over those reported at the outset of 1939.

The *ENR* Building Cost Index average was up 0.3 per cent over last year and the level at the end of the year topped the January figure by 2.3 per cent. The divergence in building and general construction costs has its explanation in the faster rate of increase in skilled labor than in common, as in the other three components the *ENR* indexes are identical.

A comparison of *ENR* Cost Indexes with other building cost indexes, Table VII, shows for three of the four only minor variations in cost averages from 1938. The fourth, the Turner Construction Co. Index for eastern cities, drops 6 points or 3 per cent. The American Appraisal Co. Index has been revised to include new factors, unemployment insurance, public liability insurance, old age pensions in various states, changes in labor efficiency, overhead charges and profit margins, which have had the effect of increasing this index of building costs by 9 per cent, or raising the originally reported 1939 average of 183 to 200. Chart 12 and the table show these revised figures.

Labor rates steady

Construction wage averages in the common labor field stayed within a range of 0.5c. in 1939. The lowest 20-cities' hourly average rate during the year, 68c. was reported in February. This rate was unchanged in March. By August it had climbed to 68.5c., the level at which it remained for the rest of the year. The net result was a new record average hourly rate of 68.3c. for 1939, 0.7 per cent gain over 1938, the former all-time high average year.

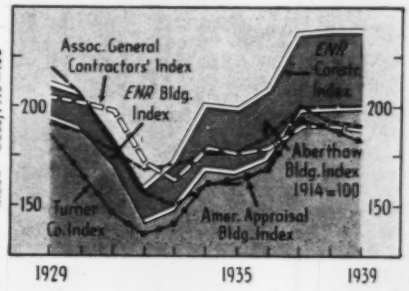
The skilled construction average rate for 20 cities revealed a wider gain than in the common field. All three trades combined to make up the skilled average wage showed increases over last year; bricklayers' and carpenters' rates were each up 1.9 per cent, and structural ironworkers', up 2.6 per cent. The overall gain for skilled construction labor was 2.1 per cent. The 1939 skilled labor average rate, $1.443, was the highest ever

VII — CONSTRUCTION AND BUILDING COST INDEXES COMPARED

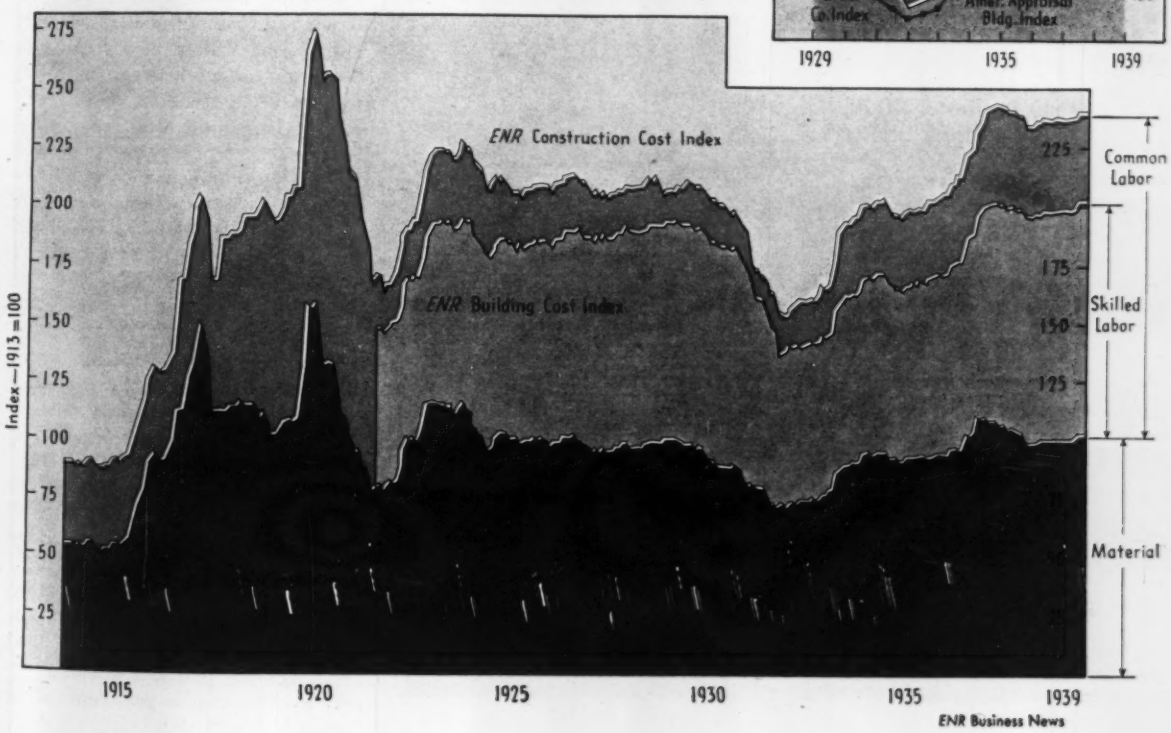
	Aver. 1929	Aver. 1932	Aver. 1939	Dec. 1939
ENR Construction	207	157	236	238
ENR Building	191	141	197	201
Amer. Appraisal (Bldg.)*	217	156	200	204
Aberthaw (Bldg.)	190	168	190	191
Turner (Bldg.)	185	136	182	192
Fuller (Bldg.)	201	157	195	194

* Revised.

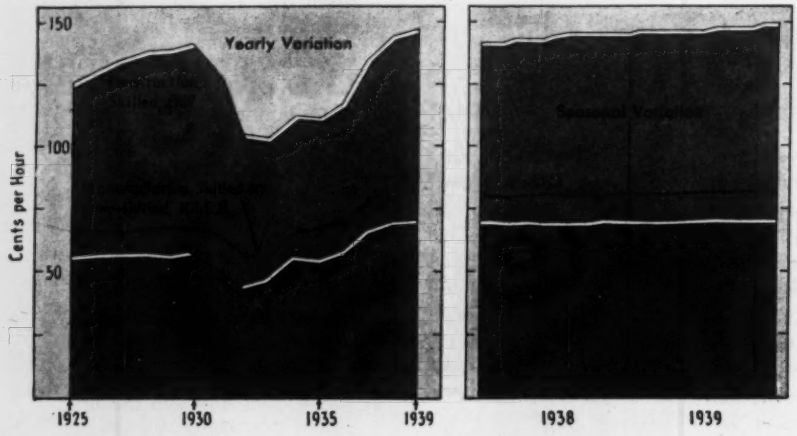
12. BUILDING COST TRENDS



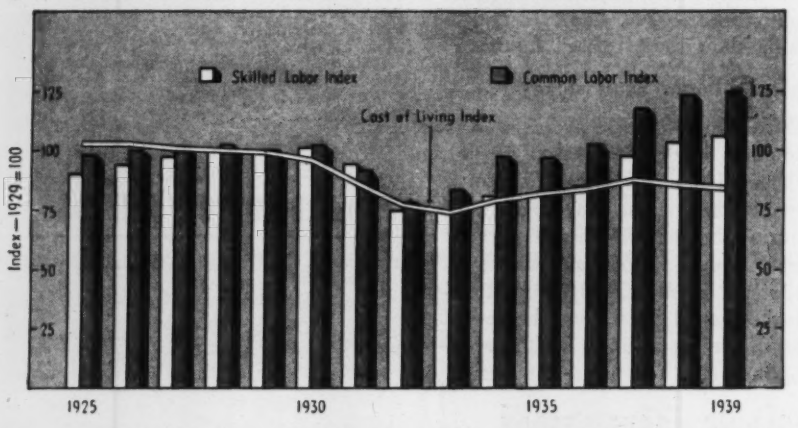
11. ENR CONSTRUCTION AND BUILDING COSTS STEADY



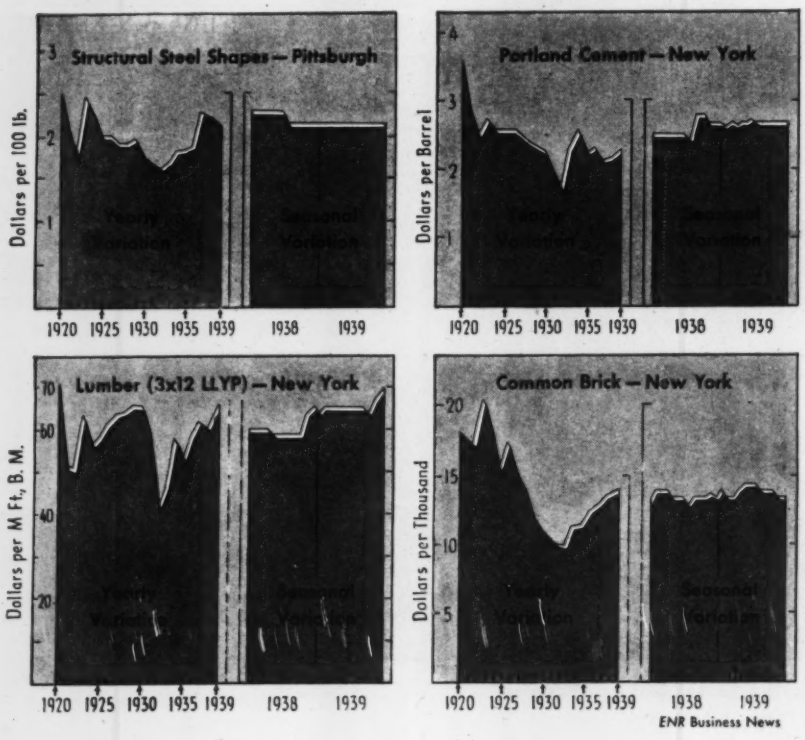
13. CONSTRUCTION LABOR RATES CONSTANT



14. CONSTRUCTION WAGES EXTEND GAINS OVER LIVING COST



15. SMALL RANGE IN CONSTRUCTION MATERIAL PRICES



reported by *Engineering News-Record.*

Common labor in manufacturing industries was even steadier than in construction, only 0.2 per cent above last year. Manufacturing skilled hourly rates trend was on a par with that of construction, indicating, according to National Industrial Conference Board figures, a 1.9 per cent rise. Comparisons of yearly and seasonal statistics are given in Chart 13.

Real income, that is actual wages in relation to living costs, continued to improve for construction workers. The 1939 index of wage rates for the construction industry based on 1929 as 100 stood at 125 for common labor and 106 for skilled, increases of 0.7 and 2.1 per cent, respectively, over 1938. The index of living costs computed by the National Industrial Conference Board dropped 1.4 per cent for the corresponding period, thus adding to the actual wage rate gains enjoyed by workers in the construction field.

Material prices

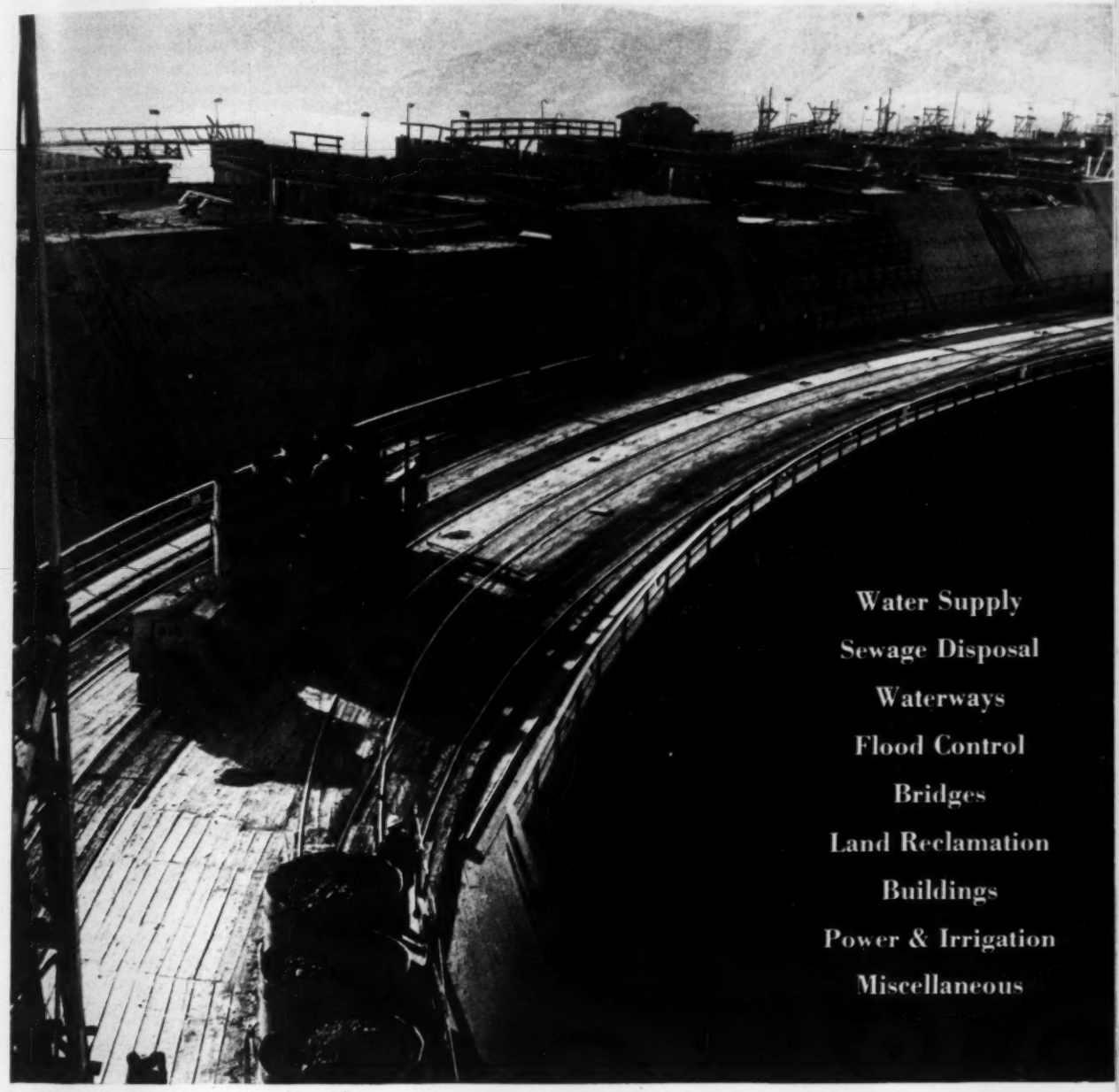
Construction material price averages for 1939 in New York were generally higher, with lumber recording an 8 per cent gain over 1938; common brick up 2.7 per cent; and cement 3.8 per cent higher. The Pittsburgh base price average for structural steel shapes, however, dropped 3.7 per cent below the 1938 average.

Long leaf yellow pine lumber in New York ranged between $63.00 in January, 1939, and $68.50 in December. For 10 months after the opening of the year, the price hovered around $63.00, but climbed rapidly in the last two months. Common brick opened the year at $13.50 and closed at $13.00. May, June and July found the price at $14.00 per M. The February, 1940, price has been increased to $14.50.

New York cement prices began 1939 at $2.15 per bbl., excluding cost of sacks, reached their peak of $2.25 in June, and then levelled off to $2.20 for the balance of the year. Structural steel shapes, Pittsburgh base price, have been steady at $2.10 per 100 lb. all year, a price which has held since July, 1938.

Cast iron pipe price average, $46.75, f.o.b. Delaware River foundries, dropped 3.3 per cent from 1938, but the year-end price, $49.00 per ton, was 6.5 per cent above January, 1939.

MAJOR PROJECTS of 1939



Briefly recorded in the following pages is the progress made on major construction operations from coast to coast. Roughly, the projects listed include operations costing over one million dollars. This compilation was made possible through the help of many engineers and contractors, who provided the data on which the individual items are based.

Construction of Chicago's 320-mgd South District filtration plant.

WATER SUPPLY

ATLANTA—Consistent progress is reported on the $1,250,000 pay-as-you-go waterworks improvement program, which was started in 1938 and which will take five years for completion to avoid borrowing funds. Already completed are the two 32-mgd sedimentation basins, the installation of a 40-mgd steam turbine-driven centrifugal pump at the raw water pumping station, and a similar unit at the high service station. Contracts for the addition of 33-mgd filter capacity will soon be advertised; distribution system improvements will be made in 1940. To finance the work, 10 per cent of the water revenue is being set aside each year.

BALTIMORE—During 1939 the work on the Gunpowder Falls-Montebello tunnel, a 34,600-ft. bore having a finished inside diameter of 12 ft., has principally been confined to lining operations, although a cut-and-cover section, 1,900 ft. long, is well under way. Of the tunnel lining, two-thirds of the total length is mass concrete and one-half of this is practically completed. About 12,000 ft. of the lining consists of a continuous welded steel plate pipe grouted inside a previously placed concrete lining; all of the concrete lining has been placed and about 7,500 ft. of steel pipe has been installed. Lining operations were completed this month.

BOSTON—The main embankment of the Winsor Dam for Quabbin Reservoir is completed and the spillway and appurtenant works are nearing completion. The reservoir has been completely cleared during the year, the river diversion tunnel plugged, and water storage has begun. Excellent progress has been made on the 18-mile pressure aqueduct (7 to 12.5 ft. dia.) from the present Wachusett aqueduct to the distribution system, only one mile remaining to be laid. Excavation of the 3-mile rock tunnel portion under the Sudbury reservoir has been holed through between all shafts. Preparations have been made to sink the first shaft of the distribution tunnel to Chestnut Hill, upon the completion of which Wachusett aqueduct pressure will be carried at that point and pumping there eliminated.

CHICAGO—The 320-mgd South District filtration plant for Chicago is well started. Both the breakwater to protect it and the cofferdam inclosing the 38-acre site have been completed and the latter unwatered. The 400,000-cu.yd. approach fill has been completed. Ten per cent of the $1,589,200 16-ft. tunnel to connect the plant with the 68th St. station is finished. Work on the East Substructure, a $3,616,000 contract, has just started and bids received on the West Substructure were opened Jan. 12. Water will be available next s[illegible] Via the 8,400-ft.-long 12-ft. Des P[illegible] tun-nel to the Cermak Pumping S[illegible] The 47th St. 16-ft. tunnel and a 10-ft[illegible] el in Stewart Ave. are well under [illegible] Some 20,000 ft. of tunnel was excavate[illegible] 1939.

COLORADO RIVER AQUEDU[illegible] Con-struction on the main line of the [illegible]rado River Aqueduct (Metropolitan W[illegible] Dis-trict of Southern California) was [illegible]pleted and first delivery of water into th[illegible],000-acre-ft. Cajalco reservoir was [illegible]e in November. Most of 1940 is to be d[illegible]ted to testing and filling aqueduct reser[illegible]s and developing a smoothly operating s[illegible]em in which five pumping plants will l[illegible] aque-duct water a total of 1,617 ft. At the end of 1939, about 75 per cent of the distribution system was completed. A modern softening and filtration plant will have an initial capacity of 100 mgd.

DELAWARE PROJECT—Construction of the first stage of the Delaware water supply project for New York City has advanced to the point where 86 per cent of the work (totaling $171,000,000) is under contract. The 85-mile aqueduct tunnel, the Merriman dam forming the first reservoir, and part of the highways and mechanical equipment are under construction. The cofferdam and diversion tunnel at the Merriman dam are substantially completed, the caisson cutoff wall to rock is being built, 37 miles of the tunnel (43 per cent of its length) has been excavated, and excavation of the full tunnel section is proceeding at the rate of more than one mile per week; concrete lining has also begun. About $49,000,000 of work has been done.

GRAND RAPIDS—Of 162,000 ft. of 36-in. concrete pipe involved in bringing Lake Michigan water to Grand Rapids, 130,000 ft. have been laid. Other items in the $4,000,000 new water supply project are a lake shore pumping station, a booster well under way, a 6,000-ft., 54-in. intake 30 per cent complete, an 8-mgd and a 16-

Glory Hole excavated in sand for the Lake Shore pumping station, a unit in the new Grand Rapids water supply. Two wellpoint header rings were used; sand stood on a slope of 1:1.

mgd reservoir which are both complete, and a 16-mgd reservoir which is 80 per cent done.

HOUSTON—A $1,000,000 PWA water improvement program was completed late in the year. It included the installation of elevated storage reservoirs and boosters, a large mileage of secondary mains and an extensive study of possible water supply sources and a valuation survey now in progress as a basis for negotiating a $14,000,000 loan for further extensions of the system and treatment plants.

LANSING—A $1,000,000 20-mgd softening plant to treat water containing 500 ppm of hardness was completed in December. It is an all-concrete monolithic structure without windows. Glass block walls furnish the light.

MILWAUKEE—One half of the $5,040,000, 200-mgd water filtration plant was placed in operation in May and the balance on July 1, 1939. Following the tuning-up period, operating results are reported to be gratifying.

MINNEAPOLIS—The 120-mgd water softening plant for Minneapolis, utilizing twelve Spaulding double cone precipitators, is nearing structural completion. The chemical building and low-service pumping station are yet to be inclosed. Equipment installation will go forward rapidly throughout the winter. Trial runs are scheduled this coming fall.

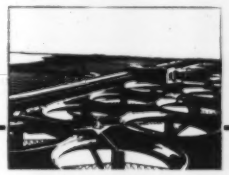
MONO BASIN—Driving the 11.3-mile Mono Craters Tunnel to increase the water supply for the city of Los Angeles was completed in 1939, and 97.5 per cent of the concrete lining was placed. Long Valley Dam, behind which Mono water will be stored, was brought to about 50 per cent completion, with some 500,000 cu.yd. of earth and rock fill in place. First Mono water through the tunnel, and hence available for the Los Angeles Aqueduct, is expected about June 1, 1940.

In November, water was first turned into Cajalco Reservoir at the lower end of the Colorado River Aqueduct.

PHILADELPHIA—The Philadelphia Authority, created in September 1938 to finance and build $20,000,000 worth of improvements to the water supply system of the city, has made no progress other than to appoint a board of engineering consultants. A new city administration took office on January 1, and it is reported that financing and other matters may soon come under consideration.

PROVIDENCE—Progress on the $1,400,000 water supply improvement project includes the completion of the $600,000 concrete lining of existing coagulation basins, and 50 per cent completion of new filtration facilities, chemical handling equipment, motor operated valve units, and a centralized control system for all plant operations.

TOLEDO—More than two-thirds of the $1,000,000 Lake Erie water supply project was put under construction during 1939. Work is being done on an intake, a 108-in. intake conduit 3 miles long, a 13-mile pipeline of 78 in. diam., an 80-mgd filter plant and a 35-mgd reservoir.



SEWAGE DISPOSAL

NEW YORK CITY—Important revisions in the New York City's comprehensive plan of sewage disposal have reduced the total number of required plants from 32 to 16; four of these are in operation, three are under construction, and others are in the design stage. During 1939, the Tallmans Island plant (40 mgd activated sludge) was put into full operation, and the Bowery Bay plant (40 mgd activated sludge) was put into partial operation. Previously put into operation were the Coney Island and Wards Island plants so that a total treatment capacity of 295 mgd is now available.

The Bowery Bay plant will be completed in 1941 and construction is also under way on the Jamaica treatment works (65 mgd activated sludge), a 35 mgd extension to the Coney Island plant, and on the smaller City and Hart Island works (1.5 mgd primary treatment). First contracts on the 26th Ward plant (60 mgd activated sludge) for the Jamaica Bay area are scheduled for award early in 1940. Provision is made in this year's budget for starting the design of the Owls Head (200 mgd), Newtown Creek (280 mgd), Classon Point (200 mgd) and Rockaway (18 mgd) treatment works.

PHILADELPHIA—The Philadelphia Authority, which was organized in September 1938 to finance and build sewage treatment and disposal facilities for the city, has taken no action other than to engage a board of consulting engineers. The new city administration which took office on January 1 may stimulate activity.

ROCK ISLAND—A $1,500,000 storm and sanitary intercepter and relief sewer system for Rock Island were completed in 1939. A $500,000 treatment plant is half done. Additional work for future contracts will include a sludge and garbage incinerator which will bring the total program to $2,500,000.

SAUGUS, MASS.—Work upon the first half of a $2,000,000 sewerage and treatment plant project is almost completed. A 20-in. force main outfall sewer, some $2\frac{1}{2}$ miles in length has also been finished.

SOUTH ST. PAUL—A $1,000,000 program involving intercepters and sewage treatment works for South St. Paul to handle large quantities of packinghouse wastes got under way in September 1939. The sprinkling filter disposal plant to handle heavy loadings (25,000 B.O.D. per acre per day) is 50 per cent complete with scheduled completion June 15. Most of the concrete has been placed in sub-freezing temperatures, with elaborate curing precautions provided.

SPRINGFIELD, MASS.—Construction of a 30 mgd sewage treatment works, with river crossing and outfalls, is about 75 per cent complete. The plant is designed to serve 190,000 persons, and will include plain sedimentation, sludge digestion and filtration and incineration of the sludge. Construction is also under way on an independent 3 mgd plant serving the Indian Orchard district of the city. Project cost is $2,600,000.

WAYNE COUNTY, MICH.—A $2,202,000 disposal project in the Detroit River area, designed to collect sewage and deliver it to a few central points, was completed last October. Six new treatment plants were built, an existing plant was reconstructed, and five intercepting sewer-lines were laid. Sludge from six of the plants is transported by truck to the largest plant, where it is dewatered and incinerated.

MEMPHIS—The 14,400 ft. intercepting sewer tunnel (7x7.8 ft.) under Front St., Memphis, was completed in 1939. This improvement, costing about $1,700,000, provides facilities to divert much of the city's sewage to the Mississippi River below the city.

LOS ANGELES—A plan for relief of overloaded sewers in Los Angeles submitted to that city November 15 by a

Chicago's Southwest Treatment Works, world's largest, placed in operation in 1939

board of consultants, recommends (1) immediate and (2) deferred relief measures. Major "immediate" items include three treatment plants and repair and ventilation of certain outfalls; total cost $17,580,000. Future items include additional trunks, a new ocean outfall and low-lift pumping plants; total cost of the project is $14,060,000.

BALTIMORE—Major additions to Baltimore's Back River disposal plant which were put into service during 1939 include a 200,000-cu. ft. heated sludge digestion tank; activated sludge units consisting of two aeration tanks, two final tanks, and two sludge thickening tanks; a blower house, containing three motor-driven centrifugal blowers each rated at 16,500 cu. ft. per min.

BUFFALO—Dedication of a 150-mgd sedimentation and sludge incineration plant in September officially placed into operation a major Great Lakes pollution abatement project costing $15,000,000. Work was then started on a $9,000,000 storm relief sewer project which will take 3 years to build.

CHICAGO—During 1939 the 5-yr. $61,000,000 PWA program of The Sanitary District of Chicago was brought to practical completion and all projects are now in operation; they collect and treat over 99 per cent of the sewage of the district, which is equivalent to 6,700,000 population. The average volume treated is 1,036 mgd. Diversion from the Great Lakes was held to 1,500 cfs as required by Supreme Court decree, and the Chicago River Controlling Works prevented any reversal of the river due to storm runoff. The 400-mgd Southwest Treatment Works was placed in full operation on the fiftieth anniversary of the founding of the District. The entire output of dried activated sludge has been sold under a contract that guarantees a substantial annual return. The Racine Ave., 1,500-cfs stormwater pumping station is now in operation. The total cost to date of all treatment facilities is $161,484,127, of which $3,395,615 was completed during the year 1939.

CINCINNATI—Plans and specifications are practically complete for the Little Miami sewage treatment works, serving some 136,000 persons in the easterly section of the city. Treatment processes will include plain sedimentation, sludge digestion, and filtration, and incineration of sludge. A comprehensive plan of sewerage is being developed for the remainder of the city.

CRANSTON, R. I.—Work upon the city's $6,000,000 sewage disposal project including sewers and a treatment plant were started in the summer, using WPA labor. About 18 miles of sewers (8 to 20-in.) and six miles of service connections have been built. Eight pumping stations and the treatment plant will soon be under construction. About 2,000 men are employed on this project.

DENVER—The Williams Fork $1,000,000 transmountain diversion tunnel to increase the dilution water available to the $1,500,000 Denver sewage treatment works was completed Dec. 1, 1939. This 3-mile horseshoe bore, 7 ft. in diameter, is concrete lined for 6,000 ft. and gunited for the remainder (except for the fully paved invert). Lining, if desired, of the entire tunnel will increase the present 275-cfs capacity to 500 cfs. Active diversion will start this spring.

DES MOINES—The 20-mgd, $1,500,000 sewage treatment plant for Des Moines went into service in January. As noted in *ENR* p. 509, Apr. 13, 1939, it is of the primary settling, trickling filter, separate sludge digestion type, and covers 57 acres. WPA did the grading, drainage and concrete work while PWA aid was utilized for the superstructures of pump and power house, sludge pump house, electrical and pipe contract and general equipment contracts.

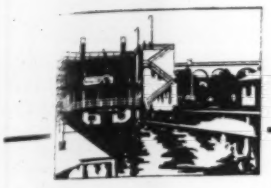
DETROIT—The largest city in the United States served by a single treatment plant has just started operation of a 420 mgd project on which construction began in 1935. The cost was $22,635,000. Treatment processes include sedimentation, chlorination, sludge dewatering and incineration; one-eighth of the volume of sludge produced is to be digested and elutriated. The plant is designed for a population of 2,400,000; present connected population is 1,600,000.

GARY, IND.—A $2,000,000, 40-mgd sewage disposal plant, combined with one of the largest garbage grinding plants to boost the gas from the digesters, is half completed with the concrete work 75 per cent placed. Utilization of gas justified the installation of the grinder. A modernistic monolithic concrete power house is a feature.

ONONDAGA COUNTY, N. Y.—Operation will begin this spring at the 4.5 mgd activated sludge treatment plant recently completed to serve Syracuse and adjacent suburbs. A magnetite filter and cascade aerator "polish" the final effluent.

NEW HAVEN—Gravity sewers are completed and construction of the 14 mgd Boulevard disposal plant is about 80 per cent completed. Work is also proceeding on construction of sludge filtration and incineration facilities for the East St. sedimentation plant. Total cost about $1,500,000.

Nature comes to the inspector's aid. When this picture was taken, wind and tide had combined to lower the New Haven harbor water level so as to show the excellent alignment of part of the city's new 36-in. submarine sewer across that body of water.



WATERWAYS

FORT PECK DAM—The placing of 122,178,000 cu.yd. of hydraulic fill in Fort Peck Dam on the Missouri River in northeastern Montana was completed on Nov. 5, 1939. Two 28-in. dredges, pumping through pipe lines up to 6½ miles long, placed 13,694,000 cu.yd. of fill in the upstream area damaged by the slide of Sept. 22, 1938, and then placed a berm at the upstream toe the full length of the dam, during the 1939 dredging season. Two of the four main control shafts on the diversion tunnels were completed during the year, and the other two were about completed. Reconstruction of the diversion tunnel intake structure, made necessary by the slide, is well along. The spillway is complete. Operations during 1940 will be confined to completing the tunnel intake, the tunnel control gates, the installation of a power plant at the outlet of tunnel No. 1, and the topping out of the dam by rolled fill taken from the downstream face of the dam. This last item will be done by contract; bids were opened Jan. 30, 1940.

NEW YORK BARGE CANAL DEEPENING—Deepening of the New York State Barge Canal with federal funds was begun in 1935 and is now about 60 per cent complete. It includes deepening 184 miles to 14 ft., widening at bends and increasing overhead clearances to 20 ft. The total cost is $27,000,000.

CAPE COD CANAL IMPROVEMENT—Deepening the Cape Cod Canal to 32 ft. and widening it to from 500 to 700 ft. at a cost of $27,000,000 is expected to be completed early this year.

CHESAPEAKE & DELAWARE CANAL—Deepening the Chesapeake & Delaware Canal to 27 ft. and widening in cuts to 250 ft. at a cost of $15,000,000 is about 85 per cent complete. Plans for a new 4-lane highway bridge at St. Georges are being prepared.

MISSOURI RIVER CHANNEL—Work on a project to obtain a 6-ft. navigable depth in the Missouri River from the mouth to Sioux City, Ia., a distance of 764 miles, has been under way for several years. It consists of construction of contraction dikes, bank revetment and dredging, estimated to cost $172,000,000. The section below Kansas City is about 90 per cent complete and that above Kansas City about 75 per cent. New work during the current year is estimated to cost $9,500,000.

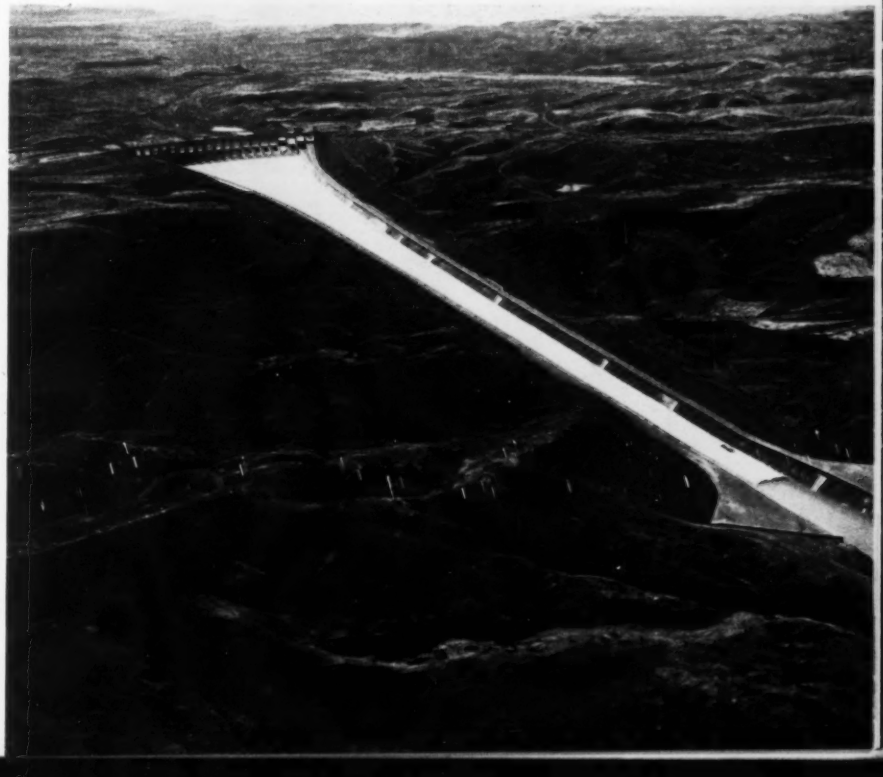
TENNESSEE RIVER—The Tennessee Valley Authority has completed three of its dams, Norris, Wheeler, and Pickwick Landing. Three more are nearing completion, and two are under construction. The Kentucky project (Gilbertsville), 22.3 miles upstream from the mouth, is under way, the construction camp being completed, most of the plant installed, and the first cofferdam started. Guntersville Dam, at river Mile 349 near Guntersville, Alabama, is practically complete, and all three generators are operating. At Chickamauga Dam, just above Chattanooga, work is practically completed except for the powerhouse. Initial filling of the reservoir is planned in February, and operation of the power units is expected during the summer and fall. The Watts Bar Dam at mile 529.9 is the most recent project authorized. The construction camp and plant have been completed, and excavation for the navigation lock is going forward in the first cofferdam. Hiwassee Dam on the Hiwassee River has grown strikingly during the year. Very little concreting remains to be done. Filling of the reservoir will begin in February, and the generating unit is expected to be ready for operation by late summer. Owing to the growth in electric load, two additional generating units are being installed at Wheeler Dam. In addition to its dam building program the authority undertakes dredging operations in the headwaters of each reservoir where necessary to facilitate navigation. Two contractors are now dredging in the channels immediately below Guntersville and Pickwick Landing dams.

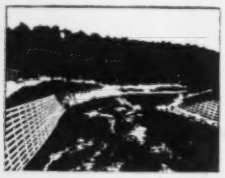
BLACK WARRIOR WATERWAY—Construction of Tuscaloosa lock and dam to replace locks and dams Nos. 10, 11 and 12 on the waterway formed by the Black Warrior, Warrior and Tombigbee rivers was completed late in 1939 at a cost of $4,321,000.

GULF COAST WATERWAYS—Deepening and improving the Intracoastal Waterway along the Gulf of Mexico was carried on actively at several points during the year. An expenditure of $9,260,000 is being made by the Army engineers on the channel from Lake Charles Harbor to the Gulf of Mexico to provide a 30-ft. depth and a width of 250 ft. The work is expected to be completed by June 1941. Jetties costing $3,400,000 are included. The Sabine-Neches waterway in Texas is being straightened and deepened to depths ranging from 25 to 36 ft., and twin jetties are being built at the mouth of Sabine Pass, at an estimated cost of $13,250,000. The jetties have been completed and dredging work is about 60 per cent complete. At Houston, work in the ship channel estimated to cost $12,000,000 is about 90 per cent complete.

UPPER MISSISSIPPI RIVER CANALIZATION—Construction of a 9-ft. channel from the mouth of the Missouri River up the Mississippi to Minneapolis at an estimated cost of $170,000,000 was authorized in 1930 and has been under way since then. Work includes 26 locks and dams. Dam No. 13 at Clinton, Iowa, and Dam No. 14 at LeClaire, Iowa, completed in 1938 and opened to navigation in 1939. Dams Nos. 17, 22 and 25 located at New Boston, Ill., Saverton, Mo. and Cap au Gris, Mo. were completed during the past year. There remains to be completed only Dam No. 24 at Clarksville, Mo., which will be in operation by the opening of navigation this year. Improvement work at St. Anthony Falls is included in the project, but has not been commenced.

Aerial view of spillway at Fort Peck Dam. Water now is being stored in the reservoir. It can be seen in the background.





FLOOD CONTROL

HANSEN DAM—The $6,000,000 rolled earth flood control dam being built by the U. S. Engineer Department on Tujunga Wash (Los Angeles County, Calif.) was 80 per cent complete at the end of 1939. Early in the year failure to find satisfactory foundation in Hansen Hill, over which the concrete spillway was to be built, necessitated redesign of the spillway as a concrete gravity structure, thus increasing the cost about $1,500,000. A feature of this work has been the operation of fifteen 25-cu. yd. carrying-scrapers working three shifts daily.

LOS ANGELES COUNTY—Flood control work along the Los Angeles River by U. S. Engineer Department included $2,000,000 for channeling, and for substitution of a steel deck truss for the old concrete arch bridge at Dayton Ave. Also, $1,500,000 for a concrete stilling basin and outlet for Verdugo Wash, including new highway and railroad bridges. San Gabriel Dam No. 1 was finally accepted; surveys were made and plans are being drawn for the Santa Fe retarding basin on San Gabriel River and a $12,000,000 basin and channel system for San Antonio Wash.

LOWER MISSISSIPPI RIVER—Construction of levees along the lower Mississippi River to the grade and section specified in the Flood-Control Act of 1928 is practically complete, comprising 2,400 miles of main river levees and earthwork aggregating 980,000,000 cu.yd. Work on the Birds Point-New Madrid floodway was completed prior to 1939 and flowage rights have been obtained for all but 1 per cent of the land. No work has been begun on Eudora floodway. In the Morganza floodway, construction of the guide levees is about 60 per cent complete and flowage easements for about 25 per cent of the land have been acquired. Flowage easements for 60 per cent of the land in the West Atchafalaya floodway have been acquired. The west protection levee has been completed. Protection levees for the lower Atchafalaya basin have been practically completed down to the ridge that separates the Atchafalaya basin from the marshland bordering the Gulf of Mexico. Dredging for the Wax Lake outlet, and additional outlet for the Atchafalaya basin authorized in 1936, has been completed except for the plug that contains the Southern Pacific railroad line and U. S. Highway No. 90. Levees along the outlet channel are about 60 per cent complete. Construction of the Charenton drainage and navigation canal, which provides an escape channel for intercepted drainage and a navigation bypass for intracoastal traffic at times when the Wax Lake outlet is in operation, was begun in 1939 and is more than 60 per cent complete. On the tributaries, construction of Sardis Dam on the Yazoo River is nearing completion and construction of Wappapello Dam on the St. Francis River is about 20 per cent complete. Levees on the St. Francis are about 20 per cent complete. Contract for 75 per cent of the White River backwater levee line has been let and the work is about 20 per cent complete.

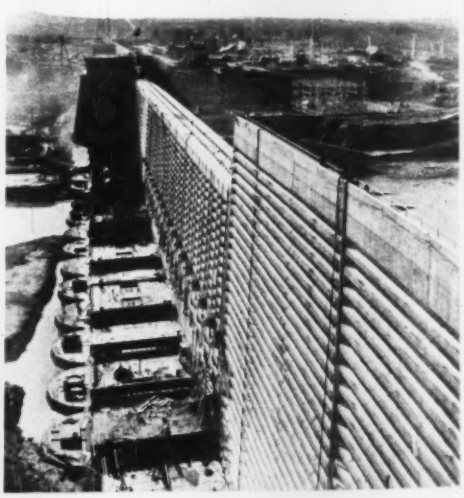
Thirteen cutoffs are now in operation in the main river and have shortened the river length by 116 miles.

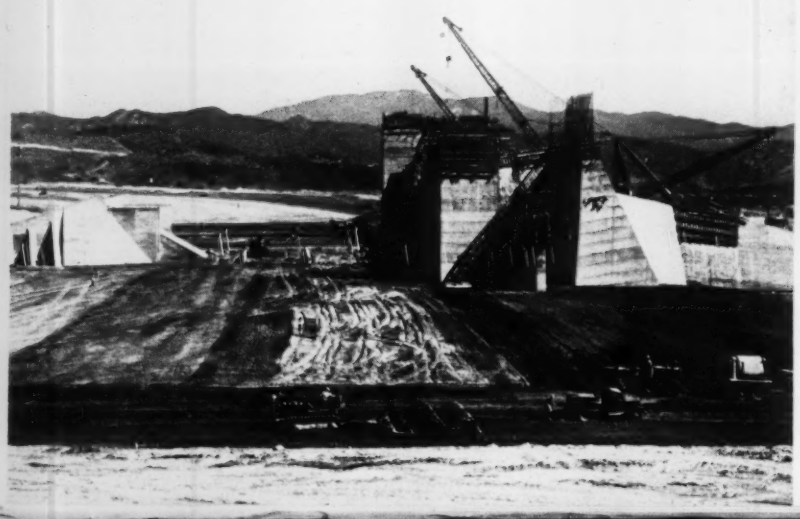
SEPULVEDA DAM—On December 21, bids were opened by the U. S. Engineer Department for construction of Sepulveda Dam, an earthfill flood control dam on upper Los Angeles River (crest length 15,500 ft., 3,000,000 cu.yd.) on which the low bid was $3,121,267.50 (Jahn-Bressi-Bevanda Construction Co.). Construction is to begin Feb. 1, 1940; relocation of 4 mi. of Southern Pacific railroad track is involved.

PRADO DAM—Construction on [illegible] hensive plan for flood control [illegible] County (Calif.) was confined to Prado Dam, the rolled earth on the Santa Ana River. The [illegible] tract on this job as a whole was to the half-completed stage [illegible] year. The ogee section of the spillway was practically comp[illegible] concrete outlet tower was fin[illegible] about 1,600,000 cu.yd. of earth ment was placed in the main da[illegible] will require a total of about [illegible] cu.yd.

POSSUM KINGDOM DAM—Construction of Possum Kingdom Dam on the Brazos River near Mineral Wells, Texas, was begun in April, 1939. It is the first of 13 flood-control dams proposed to be built by the Brazos River Conservation and Reclamation District at a cost of $50,000,000. Work is now 80 per cent complete. The dam is of the Ambursen massive-buttress type, 190 ft. high above the foundation rock, with buttresses on 40-ft. centers. A power plant of 37,500 kw is included in the project.

MARSHALL FORD DAM—Construction of the high 270-ft. Marshall Ford Dam, major flood control feature of the Colorado River Project in Texas, is 54 per cent completed. Work is now in progress on the enlarged dam, which will cost $23,000,000 and provide 3,000,000 acre-ft. of storage. The low 190-ft. dam costing $12,000,000 was completed last August. The present contract calls for 341,000 cu. yd. of concrete in a row of blocks 52 ft. thick and 100 ft. or more high along the upstream face of the low dam. Of the 1,365,000 total





Marshall Ford Dam (above). Work is shown in progress on new blocks being placed on the upstream face. At the left is a general view of the intake and spillway structures for Hansen Dam.

Conchas Dam on the South Canadian River in New Mexico was completed early in 1939.

yardage 61 per cent had been placed at the end of the year. A 1,500,000-cu. yd. earth and rock fill 100 ft. maximum height at the left abutment is included in the full development.

RIO GRANDE CANALIZATION—Along 100 miles of the Rio Grande above El Paso, canalization was continued by the U. S. Section, International Boundary Commission. This $4,270,000 project will involve 13,000,000 cu.yd. of earthwork in the river channel feature and also includes the recently-built American diversion dam near El Paso. Levee construction and channel excavation are in progress on the canalization feature, which is about 40 per cent completed. The project is designed for flood protection and the control of irrigation waters for American lands and for delivery to Mexico under the treaty of 1906.

LOWER RIO GRANDE—During 1939 the United States and Mexico continued the construction of the International flood-control works in the Rio Grande delta region. The United States portion includes 120 miles of levee along the Rio Grande, 180 miles of floodway channels and 200 miles of floodway levees and will cost $9,390,000. Last year $1,700,000 was available. The United States portion is half completed and work is now under way on levee construction along the river and channel improvement along the North Floodway in Cameron and Hidalgo counties. The Mexican Government is building the river and floodway levees on the southerly side of the international river.

PENSACOLA DAM—The Pensacola multiple arch dam, under construction on the Grand River in northeastern Oklahoma, was 85 per cent complete at the end of the year. A total of 453,000 cu.yd. of concrete has been placed, with 57,000 cu.yd. remaining. The auxiliary spillways to the east of the dam are practically complete. Construction of the power house, to contain four power units, is well along. The hydraulic turbines are now being installed.

NEW ENGLAND FLOOD CONTROL—Contracts were let last year for three of the many dams planned for flood control of the Connecticut and Merrimack Rivers. A fourth dam, on the headwaters of the Connecticut, was started over a year ago by the State of New Hampshire.

Pittsburg Dam—This rolled fill structure, 2,100 ft. long and 100 ft. high, at the headwaters of the Connecticut River in northern New Hampshire was practically finished last year. It is being built by the state; all of the other dams on the watershed are built by U. S. Engineers.

Franklin Falls Dam—Contract was awarded late in 1939 for construction of this dam on the Pemiewasset River in New Hampshire. It will be of rolled-fill construction with a rock face, 1,700 ft. long and 130 ft. high, containing 2,200,000 cu.yd. of rolled fill and 575,000 cu.yd. rock.

Surry Mountain Dam—Construction of this rolled-fill structure, 1,670 ft. long and 83 ft. high, containing 900,000 cu.yd. of fill, was started last summer on the Ashuelot River in New Hampshire. Last fall the site of the dam was cleared and stripped, and a short diversion tunnel driven.

Knightville Dam—Construction work on this 1,000,000-cu.yd. hydraulic-fill dam on the Westfield River in Massachusetts has been confined to driving the 650-ft. diversion tunnel, now about 60 per cent complete, and clearing and stripping the dam site. The structure will be 1,200 ft. long and 160 ft. high.

Levees and Flood Walls—Local protection works are under construction along the Connecticut River at Northampton, Chicopee, Holyoke, West Springfield and Springfield, Mass., and East Hartford and Hartford, Conn.

OHIO RIVER BASIN FLOOD CONTROL—Flood control projects are under construction in the Ohio River Valley from the headwaters of the Allegheny and Cumberland Rivers to the lower reaches at Paducah, Ky.

Crooked Creek Dam—This 1,200,000-cu.yd. earth and rock-fill dam under construction on the headwaters of the Allegheny River in Pennsylvania, is 86 per cent complete.

Tionesta Dam—This project, the largest of all in the Ohio Valley, containing 2,000,000 cu.yd. of earthfill, located on a tributary of the Allegheny River in Pennsylvania, was 75 per cent complete at the end of the year.

Mahoning Dam—This concrete gravity section dam, 993 ft. long and 160 ft. high, containing 233,000 cu.yd. of concrete, located on Mahoning Creek on the west slope of the Allegheny Mountains in Western Pennsylvania, is about 35 per cent complete.

Loyalhanna Dam—Work has just started on the Loyalhanna Dam on Loyalhanna Creek in Western Pennsylvania. This is concrete gravity section structure, containing 100,000 cu.yd. of concrete.

Johnstown Channel Improvements—The first section of extensive channel improvements, including railroad and highway relocations, has been completed on the Conemaugh River just below Johnstown, Pa. The second section is about 25 per cent complete and a third section has just been started.

Levees and Flood Walls—Local protection works are under construction at the following points along the Ohio River: Wellsville and Ironton, Ohio, the latter project includes the Storms Creek diversion channel; Huntington, Ceredo and Kenova, W. Va.; Gill Township, Evansville, Brevoort Levee, Lyford Levee, and Tell City, Ind.; Harrisburg, Ill. and Paducah, Ky. Local levees are also being built at Middlesboro, Ky.

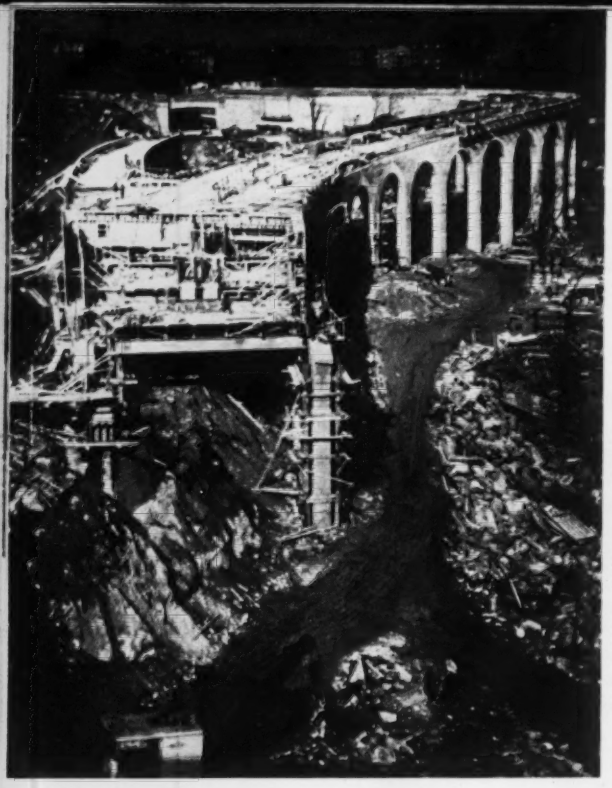
SUSQUEHANNA RIVER FLOOD CONTROL—*Arkport Dam*—The Arkport Dam on the Canisteo River near Hornell, N. Y., under construction since May, 1938, is practically complete. It contains 900,000 cu.yd. of rolled fill and 14,000 cu.yd. of concrete.

Whitney Point Dam—This 2,600,000-cu.yd. rolled-fill structure on the Otselic River in New York is now about 30 per cent complete. Contract was let in September, 1938, for $2,700,000.

Levees and Flood Walls—Levees at Kingston and Wilkes Barre, Pa., are about two-thirds complete, and two sections of channel improvement on the Canisteo River at Hornell, N. Y., are complete.

Indian Rock Dam—Contract was awarded in December, 1939, for the Indian Rock Dam on Codorus Creek near York, Pa. The dam is of rolled earth construction, with rock-fill shells, 1,000 ft. long, 80 ft. high, containing 290,000 cu.yd. earth fill and 190,000 cu.yd. of rock.

BRIDGES



Harlem River speedway connection to George Washington Bridge, one unit in the span's far-flung approach system. A tunnel from the bridge through the backbone of Manhattan joins the maze of ramps and grade separations here shown taking shape; the speedway is to the right of the picture, which was taken from High Bridge.—

R. A. Wurgel Photo

GEORGE WASHINGTON—Extension of the Manhattan approach to this famous Hudson River crossing at New York City was brought close to completion with the construction of a viaduct in Highbridge Park connecting the existing Harlem River Speedway with the two-lane vehicular tunnel under 178th St. that extends to the bridge plaza. The cost of the viaduct is set at $3,000,000.

WHITESTONE BRIDGE—This 2,300-ft. span suspension bridge, fifth longest in the world, carrying two three-lane divided roadways and connecting the boroughs of Queens and The Bronx, New York City, was opened to traffic during the year. (*ENR*, Aug. 3, 1939, p. 149 and Aug. 17, 1939 p. 206).

MEEKER AVE., N.Y.C.—The 6,400-ft. steel and concrete viaduct connecting the boroughs of Brooklyn and Queens, New York City, and known as the Meeker Ave. Bridge, was opened to traffic during the year. Its main span over Newtown Creek is a 300-ft. through truss providing 125-ft. vertical shipping clearance. (*ENR*, Nov. 23, 1939, p. 706.)

MAIN AVE., CLEVELAND—Completed and opened, except for one ramp connection, this high level bridge was one of the largest of the year. Costing $7,200,000, the project is 8,000 ft. long, including ten deck cantilever trusses, totaling 2,520 ft. Longest span is 400 ft., carried 120 ft. above Cuyahoga River. In the elaborate approaches are 1,400 ft. of steel rigid frame construction, including two three-span all-welded units, 1,500 ft. of concrete rigid frame and bent construction and a continuous steel girder layout that includes a span of 271 ft., longest in the United States.

ATCHAFALAYA RIVER—Conversion of two 304-ft. simple spans into a cantilever bridge with 444-ft. main span and 439-ft. anchor spans (by utilizing the simple spans as the ends of the anchor arms) is another outstanding railroad bridge job brought to virtual completion at the end of the year. It is located at Krotz Springs, La., on the Missouri Pacific. The bridge lengthening was made necessary by the need for doubling the channel capacity of the Atchafalaya River.

TACOMA NARROWS BRIDGE—The suspension bridge near Tacoma, Wash., with a 2,800-ft. central span, the third longest in the world, reached the cable spinning stage during 1939. Difficult foundation work was completed, towers were erected, catwalks were practically compl[illegible] and spinning was scheduled to start [illegible] in January 1940. Of the two main p[illegible] one was sunk to 175-ft. and the other [illegible] 225-ft. depths using false bottomed [illegible]ssons. Towers have a slenderness ratio of [illegible] July 1940 is the date scheduled for completion of the structure.

DEER ISLE—Opened in June, the 1,080-ft. span suspension bridge connects Sedgwick, Maine with Deer Isle, a coastal island. Cables consist of prestressed strands, and the difficult deep-water foundation job required was solved by lowering completely assembled sheet pile cofferdams prefabricated to fit the rock contours. (*ENR* Aug. 18, 1938, p. 207.)

HUTSONVILLE, ILL.—Completed in 1939 the new bridge over the Wabash River between Indiana and Illinois connecting the towns of Sullivan and Hutsonville, is the fifth self-anchored suspension bridge in the United States. The main span is 350 ft. and each cable consists of nine $1\frac{1}{2}$ in. galvanized rope strands arranged in open formation. Stiffening girders are 36-in. rolled sections.

HOUSATONIC RIVER—Notable for its use of one-leg bents and an open steel-grating floor, this deck plate girder crossing of the Housatonic River on the extension of the Merritt Parkway in Connecticut was brought to the stage of foundation completion at the end of the year. The river crossing will consist of a cantilever

Butler Aw Photo

Cleveland's new Main Avenue bridge permits through traffic to by-pass the business district, which is reached over the bridge at right.

layout with a 224-ft. main span and 160-ft. anchor spans. Approaches consist of 160- and 128-ft. spans in continuous girder layouts. Total length, 1084 ft. (*ENR*, July 27, 1939, p. 114.)

NATCHEZ—Foundations are complete and steel erection is just getting started on the five-span continuous cantilever crossing of the Mississippi River at Natchez, Miss., a 2-lane toll bridge financed by an RFC loan and a PWA grant. Piers are founded from 80 to 150 ft. below mean low water. Anchor arm and cantilever span lengths vary from 559 to 875 ft. Total length of project, including approach roads and viaduct, is 8,135 ft.

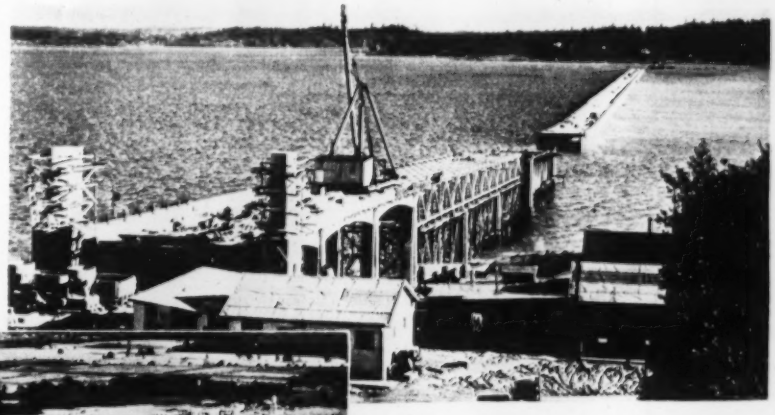
GREENVILLE—Located 9 miles below the town of Greenville, Miss., so as to be at a stable point in the river below the famous Greenville Bends, this RFC and PWA financed project extends for nearly 12,000 ft. between the Mississippi River levees. Main river crossing is a cantilever bridge of 840-ft. main span with 640-ft. anchor arms resting on piers extending from 125 to 160 ft. below mean low water. Steel viaduct approaches of over a mile on the east side and of about 2000 ft. on the west side are nearly complete. Main river piers are finished.

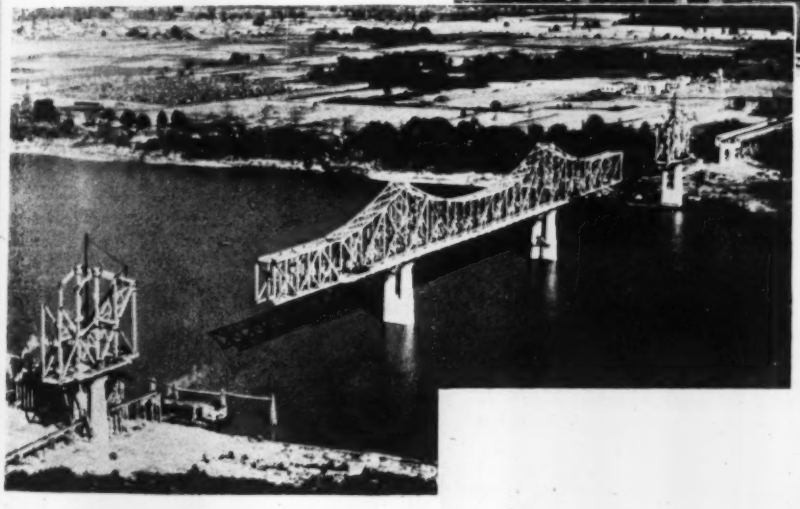
BATON ROUGE—Approach viaducts and roads are complete and steel erection on the main bridge is about 75 per cent finished on the $10,000,000 combined state highway and railway crossing of the Mississippi River at Baton Rouge, La. The main bridge consists of five spans—490-ft. anchor spans at either end, a 650-ft. center-anchor span and two 848-ft. cantilever spans. Opening date is about June 1, 1940. (*ENR*, Jan. 20, 1938, p. 106).

ROCK ISLAND—Foundations are complete and steel erection about half finished on the new Mississippi River toll bridge between Rock Island, Ill. and Davenport, Iowa, being built to relieve traffic on the Arsenal Island bridge some distance upstream, which carries 9 million cars annually on a two-lane deck that also accommodates street cars. The new bridge, whose deck accommodates two 22-ft. divided roadways, is notable for its financing, which is one hundred per cent from private sources, and for its five steel tied-arch spans varying in length from 394 to 538 ft. It also includes some 1500 ft. of plate girder approaches.

LAKE WASHINGTON BRIDGE—The concrete pontoon bridge floating on Lake Washington at Seattle, took form rapidly during the year, and 12 pontoons, each 350-ft. long (about 2/3 the ultimate total length of 6,561 ft.) were anchored in place. Special pontoons for the floating draw-span are scheduled for placement early in 1940. Work is well along on tunnel and other approach structures and the entire project is now expected to be completed within the estimated cost.

RARITAN RIVER BRIDGE—All ten of the pneumatic caissons for foundations of the new high-level highway bridge across the Raritan River above Perth Amboy, N. J., have been completed, and the piers for the north and south approaches are about complete. Steel erection has started on the north approach. The bridge, carry-





Almost across. When this view of the Lake Washington bridge was taken, the pontoon section of the job had almost closed with the ramp from Seattle. In the distance can be seen Mercer Island.

Mississippi River Bridges. Above is shown end-of-year progress on the $10,000,000 rail and highway bridge at Baton Rouge, La. At the right, steel arches span the river between Davenport, Iowa and Rock Island, Ill.

Davenport Times Photo

ing six traffic lanes, will be 4,388 ft. long, made up of 29 spans of deck plate girder construction, with a center span of 250 ft. The structure will greatly lessen the congestion of shore traffic, and is expected to be completed by June, 1940.

CHICAGO BRIDGES—The old State St. bridge over the Chicago River was demolished to permit the sinking of twin tubes for the city's new subway. A new double-leaf bascule will be started this year; its foundation is to straddle the subway. Redecking the Michigan Ave. bridge with asphalt plank on concrete was one of the largest maintenance jobs of the year.

CIMMARRON RIVER, C.R.I. & P. R.R. Placed in service during the summer, a bridge across the Cimarron River near Liberal, Kan., on the Rock Island Lines was an outstanding railroad structure of the year. Part of a line-shortening operation involving 8 miles of heavy grading, the bridge consists of five 250-ft. truss spans set 90 ft. above the river. Concrete foundation piers of pleasing design rest on caissons sunk 65 ft. below the riverbed.

POTOMAC RIVER BRIDGE—Foundations for the new bridge across the Potomac River at Ludlow Ferry, Md., 15 miles below Washington, are well under way. About one-third of the two-mile length of structure is made up of short I-beam spans carried on steel piles; the remainder of the structure is mostly Wichert deck girders and Wichert trusses, with a [illegible] span of 800 ft. over the navigat[illegible] nel providing a clearance of 145 [illegible] mean high water. The foundation[illegible] some of the longest steel piles e[illegible] —194 ft., all H-beam sections. S[illegible] for both river piers and trestle, [illegible] 37.5 miles in length and weigh 10[illegible] The river piers consist of two s[illegible] sons of two and four cylinders e[illegible] nected by steel diaphragm walls, [illegible] to timber platforms at river bed, [illegible] which the foundation piles had p[illegible] been driven. Five of the 20 ri[illegible] piers have been completed, and foundat[illegible] piling has been driven for more than [illegible] of them. The trestle bents are about three-fourths complete. Erection of steel has not yet been started.

LAND RECLAMATION

BOISE-PAYETTE—The 27-mile Black Canyon main canal, to serve 47,000 acres in the Payette division of the Boise project in southwestern Idaho, was completed and work was in progress on the "A" and "D" line canals and the lateral system. Investigations were made of the Cascade reservoir site on the North Fork of Payette River as a source of supplemental water supply. Approximately $6,700,000 will be expended on this division.

PROVO RIVER—At the Deer Creek dam on the Provo River in Utah, the contractors made good progress and at the end of 1939 had completed one-half of the work on the dam, highway and railroad relocation. With almost 3,000,000 cu.yd. of material in the embankment, the dam is one of the largest of the earth-fill, rock-faced type to be undertaken by the Bureau of Reclamation. It is 150 ft. high and will cost about $3,900,000. The Olmsted tunnel on the Salt Lake Aqueduct was completed in November and excavation operations were in progress at the Alpine-Draper tunnel. The estimated cost of the entire project amounts to about $15,774,000.

TRUCKEE RIVER STORAGE—The Boca dam and reservoir on the Little Truckee River in California, just west of the Nevada state line, was completed in August. The structure is a rolled earth embankment, with rock fill on the downstream slope, 110 ft. high and 1,650 ft. in length along the crest.

UPPER SNAKE RIVER—Grassy Lake dam on Grassy Creek in northwestern Wyoming, was completed in October. It is an earth and rock-fill structure with a maximum height of 120 ft. and a crest length of 1,200 ft. The reservoir will store 15,000 acre-feet.

GILA—The first unit of the Gila project, now 22 per cent completed, contemplates the irrigation of 139,000 acres of mesa lands, lying directly east of the Yuma project, and 11,000 acres in the North and South Gila valleys. Earthwork on the gravity main canal is completed to the site of the pumping plant near Blaisdell. The Fortuna spillway is 70 per cent complete. A 161,000-volt transmission line, 120 miles in length, is being constructed from the Parker power plant to pumping plant No. 1 near Fortuna Siding. The pumping plant is the next construction job to be undertaken. It is designed for an ultimate installation of six units, five of 400-cfs capacity and one having a capacity of 200 cfs. The initial installation, now on order, comprises three units with capacities of 100, 200 and 400 cfs.

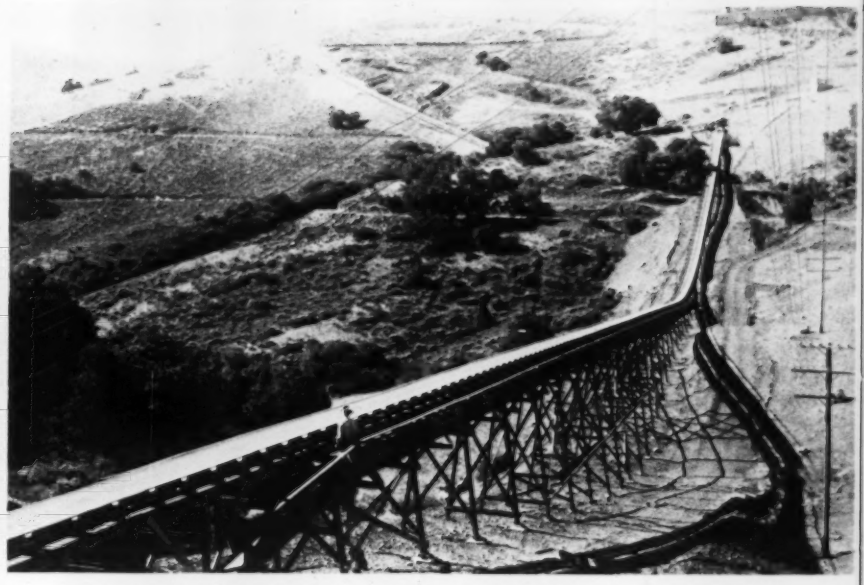
CENTRAL VALLEY PROJECT—All along a 350-mi. front, construction was in progress during 1939 on California's Central Valley project, more specifically as related below. Total contracts awarded exceed $72,000,000. About 5,000 men were employed Jan. 1.

Kennett Division—Excavation for Shasta Dam was practically completed; the railroad began using the bypass tunnel in June; stream diversion channel was well along; erection of the 460-ft. head tower for the radial cableway systems was far advanced; construction had started on the 9½-mi. belt conveyor for delivering aggregates, and all activities were shaping toward the placing of first concrete in the dam early in 1940.

Railroad Relocation—On the 30 miles of new Southern Pacific main line that will go around the reservoir, much of the grading had been done, six of the twelve tunnels had been holed through and concrete lining completed in two; track was laid some eight miles north of Redding. The new line is to be ready for traffic in September, 1941. On the $5,000,000 double deck bridge which will carry railroad and highway over Pit River (piers 350-ft. high, upper deck 500 ft. above

Green Mountain Dam diversion tunnel was finished during 1939.

As the new year came in, this was the status of construction on the 460-ft.-head tower at Shasta Dam.



Across more than nine miles of California hill-side winds this belt conveyor, built to haul aggregates from Reading to the site of Shasta Dam. Material will be in transit an hour and forty minutes.

stream bed) contract was awarded in November ($1,138,288) for piers and abutments. Since Jan. 1, 1940, the bridge superstructure contract has been let.

Delta Division—Of the 46-mi. Contra Costa canal, 20 mi. was completed, work was under way on nine miles and 17 mi remained to be contracted.

Friant Dam—Contract was awarded on Friant Dam (bid $8,715,359; concrete 1,850,000 cu.yd.) to store water on the San Joaquin River, and construction was started early in November. Bids were opened late in December on the first 8½ mi. of the 1,000 cf-canal extending northward from Friant Dam. Location work has continued on the 160 mi. of canal to extend southward from the site of Friant Dam.

DESCHUTES—The Deschutes project serves an irrigable area of 50,000 acres on the east side of Deschutes River, in Jefferson County, Oregon. Work on the first 19-mile section of the 65-mile main canal is 62 per cent completed. Contracts were awarded in August for the construction of the Crane Prairie dam and outlet works at Wickiup dam, both on the upper Deschutes River. Crane Prairie is a rolled earth embankment with a layer of rock riprap on the upstream slope and a rock fill on the downstream slope. It is 35 ft. in maximum height above the river bed, 285 ft. long, and will store 50,000 acre-feet. Wickiup dam is an earth-fill, rock-faced structure 84 ft. high, and forms a reservoir with a capacity of 180,000 acre-feet. The Wickiup embankment and the main canal are being constructed by force account. On the contract work the Wickiup outlet works are 16 per cent completed and the Crane Prairie Dam project is 41 per cent completed.

PINE RIVER—Work on the Vallecito earth-fill dam on Pine River in Southeastern Colorado, was 65 per cent complete, when weather conditions caused a suspension of operations in late November. This structure will require the placing of 3,440,000 cu. yd. of earth and rock fill, and has a maximum height of 150 ft. and crest length of 3,965 ft. The project serves 69,000 acres of Indian and white lands in LaPlata and Archuleta counties, and will cost $3,000,000.

YAKIMA-ROZA—The Roza division of the Yakima project, comprising 72,000 acres in south-central Washington is 47 per cent completed. Construction of irrigation works for the division will cost $18,085,000. The Roza diversion dam, a concrete gravity weir across the Yakima River, near Pomona, is practically completed. Twenty-six miles of the 90-mile Yakima Ridge Canal have been completed and work is in progress on an additional 14 miles. A contract was awarded in August for construction of Wasteway No. 3. A power plant containing two 6,000-kva. units will be located at the end of the upper 12-mile section of the main canal, where a head of 140 ft. is available for power generation.

COLORADO-BIG THOMPSON—At the Green Mountain dam site on the Blue River, near Kremmling, Colorado, excavation was in progress and the outlet tunnel for diversion of the river was completed. The dam is of the earth and rock-fill type with a maximum height of 270 ft. and a crest length of 1,300 ft. It will contain 4,366,000 cu. yd., the largest structure of its type ever undertaken by the Bureau of Reclamation. The present contract includes building a power plant, which will house two 12,000-kva. generating units. Transmission lines were completed from Green Mountain to the Granby pumping plant site and the west portal of the Continental Divide Tunnel; also from Loveland to Estes Park and the east portal of the tunnel. A contract was awarded in December for 70½ miles of 115,000-volt transmission line from Greeley to Wiggins, Fort Morgan and Brush. At the end of the year, no action had been taken on a second set of bids received on construction of the Continental Divide Tunnel, 9 ft. 9 in. in diameter and 13.1 miles in length. A headquarters office was established at Estes Park in October and the Shadow Mountain camp near Granby is under construction.

KENDRICK—Seminoe Dam, a concrete-arch structure, 294 ft. high, on the Platte River, near Rawlins, Wyoming, was completed in January 1939 at a cost of about $5,000,000. It forms a reservoir of 1,020,000 acre-feet capacity to provide an irrigation supply for 35,000 acres in the vicinity of Casper. A power plant at the dam has an installed capacity of 45,000 horsepower with three units. Installation of the third 12,000-kva. generating unit was completed in July. Transmission lines from Seminoe to Cheyenne, Wyoming, Cheyenne to Greeley, Colorado, and Cheyenne to Gering, Nebraska, were completed. Excavation work on the Casper Canal and distribution system was continued during the year with government forces. The first unit of the project is now 83 per cent completed.

BUFFALO RAPIDS—Construction of an irrigation system for 12,000 acres, lying along the Yellowstone River, between the towns of Glendive and Miles City, Montana, was nearing completion by government forces at the close of the year. The work included a pumping plant, main canal and lateral system. Power for pumping will be furnished by the Montana-Dakota Utilities Company. An additional unit of 9,800 acres near the towns of Shirley, Terry and Fallon, to cost $1,450,000, was authorized for construction in October.

SHOSHONE-HEART MT.—Earthwork and structures on the Heart Mountain main canal have been practically completed for 23 miles of its total length of 28 miles.

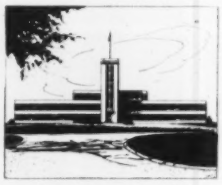
When temporary supp[orts] are removed, this inverted [siphon] across the Shoshone Riv[er] will be the longest self-sup[porting] pipe span in the world.

Shoshone River is crossed by an inverted siphon of concrete barrel and welded plate-steel pipe, 10 ft. 3 in. in diameter and 1,700 ft. long, capacity 914 cfs and with a maximum head of 205 ft. The siphon was completed in December. Work was in progress on the Buck Springs Creek siphon, which has a diameter of 8 ft. 8 in. and a total length of 3,208 ft. A contract for construction of the Shoshone Canyon Conduit controlling works and tunnels was awarded in August. This division of the Shoshone project comprising 42,000 acres will cost $6,500,000 and is now 52 per cent complete.

TUCUMCARI—Three contracts amounting to $1,946,000 and covering earthwork, tunnels and structures on the first 25-miles of the 55-mile Conchas Canal were ready for award at the end of the year, bids having been opened in November. An irrigation system for 45,000 acres in Quay County, New Mexico, is planned, with water taken from the Conchas reservoir, recently completed by the Army Engineers (see p. 103). The estimated cost of the Tucumcari project is $8,155,000.

GILA PROJECT.—The construction of the siphon across the Gila River 19½ ft. in diameter and 2,100 feet long was completed under contract during 1939. An additional contract was completed during 1939 involving the construction of a number of structures along the 20-mile gravity canal section of the Gila Project involving drainage inlets, overchutes, spillways, turnouts, and the construction of the 19½-ft. diameter Fortuna Wash siphon. An additional contract was entered into during the year involving the construction of two highway bridges and the Fortuna Wasteway.

ALL-AMERICAN CANAL—During 1939 the four power drop structures were completed under two contracts. There was also completed under contract the drop structure and turnout structure for the headworks of the Coachella Canal. An additional contract provided for the construction of the Alamo River Crossing and the Central Main Check and Turnout. Still another contract provided for the construction of numerous turnouts and checks for the purpose of supplying water to the present cultivated lands in the Imperial Valley, and also for the purpose of supplying water to undeveloped lands for which the lateral systems have not yet been constructed. Good progress was made on the excavation contract for the first 40 miles of the Coachella Canal. The excavation of and the construction of all structures on the second 40-mile reach of the Coachella Canal was placed under contract during June and active construction work began during the fall months.



BUILDINGS

CHAMBER OF COMMERCE, HOUSTON—Addition of 13 all-welded stories to the Chamber of Commerce Building in Houston brought its height to 22 stories and made it a prominent mark on the city's skyline. Welding was adopted to reduce noise that would have disturbed tenants. The new addition is completely air conditioned.

HOSPITAL, JERSEY CITY—Added to the Jersey City Medical Center was the 16-story Margaret Hague Memorial Hospital and a 23-story nurses home, both entirely arc-welded, the latter believed to be the tallest welded building in the country.

FOOD TERMINAL—Built by Kansas City, Kan. and leased to the Union Pacific Railroad, a $4,000,000 market and terminal was opened in December to centralize inspection, handling and reshipment of perishable foods. Covering a 63-acre hydraulic filled site, it includes a 3¼ million-bushel grain elevator, four reinforced concrete produce buildings 450 ft. long and a 2 million-cu.ft. cold storage warehouse as well as five steel frame roofed sheds covering a farmers market. All buildings are on piles.

STATE OFFICE BUILDING—Approaching completion at the end of the year was the new 14-story Kentucky state office building at Frankfort, notable for its all-welded frame. Some 214x84 ft. in plan, the building adoins a new 1,500-seat auditorium. Steel tonnage was 1,470. Three upper floors are air conditioned, with provision made for future air conditioning throughout the building.

BAKING SODA FACTORY—An all-welded frame, solid walls of brick and glass block and striking mass and facade effects featured a multi-story industrial building for baking soda manufacture in Syracuse, N. Y. Particularly notable were several different types of air conditioning and welded connections carrying 250,000-lb. reactions. (*ENR* Oct.26,1939p.570)

AIRPLANE FACTORY—Heralded as the fastest building job on record, a 2-story $1,800,000 assembly building, 685 ft. long and 300 ft. wide, was added to the Glenn L. Martin Co. airplane plant in Baltimore in 11 weeks from the time the design contract was let. First story is reinforced concrete with 25-ft. panels, second story structural steel with 50x100 ft. panels. (*ENR* June 22,1939p.834)

MULTI-STORY FACTORY—A 6-story reinforced concrete manufacturing building of 291,000 sq.ft. floor area for Parke, Davis & Co. in Detroit is a striking example of multi-story factory construction.

Close control of sanitation and air conditioning is the keynote of design. Glazed tile is used throughout the interior walls. Seven distinct plumbing systems are required for manufacturing, biological, sanitary, rainwater, analytical, floor drains and vacuum pan service. Air conditioning applications vary in different sections of the building, some requiring very exact regulation, others stainless steel hoods or cement-asbestos ducts to withstand corrosion. Center of the building is lighted at the first floor by monitors located in light court which furnishes ample daylight for the five other floors.

AIRPLANE ENGINE FACTORY—Typical of best modern practice in single story industrial buildings is the 960x250-ft. airplane engine factory of Pratt & Whitney, Division of Niles-Bement-Pond Co. in Hartford, Conn., constructed of steel frame and metal deck roof with steel sash in sidewalls and monitors. An outstanding feature is the fact that all sash lines in sidewalls and monitors continue in bands around the entire building eliminating all blind spots. Creosote block is used for flooring except for certain areas of flexible strip wood block. As a part of the project there are also a combination steel frame, concrete floor building, 522x242 ft., used for pattern storage, garage and boiler house and a 2-story, 245x155-ft. administration building.

NYLON PLANT—Manufacture of nylon yarn (for women's hose, etc.) was begun in December by E. I. du Pont de Nemours & Co. in the first unit of a new plant at Seaford, Del. First of its kind to be built, the first unit is a building 1052x272 ft., one-story high, except for a six-story tower at one end, and completely air conditioned. There is also a power plant and two-story administration building in layout. Both rail and river transport facilities are provided.

LAFAYETTE BUILDING—Washington's largest privately-owned office building was 25 per cent complete at the end of the year, with the framing nearly topped out. A 12-story and 2-basement structure with 350,000 sq.ft. of rentable space, its construction will cost about $5,700,000, and land will bring the total cost to $8,100,000. The building is of steel frame type with tile arch floors; though mostly founded on spread footings, it utilizes 168 concrete piles. Unusual features are provision for inside storage of 130 automobiles and an air-conditioning system separately adjustable from each room.

ELECTRIC GENERATING PLANTS—A total of 1,284,830 kw generating capacity was placed in service in 1939, of which 1,078,630 kw was by private companies. Hydroelectric installations accounted for 375,150 kw of the added capacity. In addition, work was started on other plants that will place 2,011,090 kw in operation in 1940 and 996,600 kw in 1941. Some of the larger installations are listed below.

Potomac Electric Power Co.—New $5,000,000, 50,000-kw plant at Washington, D. C., started in August, 1939, to be completed in 1940.

Public Service Electric & Gas Co.—Addition to Burlington, N. J., plant totaling 100,000 kw and costing $11,300,000, started in June, 1939, to be completed in 1940. Additions to the Marion (Jersey City, N. J.) plant, 50,000 kw, to be completed in 1941 at a cost of $7,500,000.

West Penn Power Co.—New 60,000 kw plant at Power, W. Va., completed in 1939.

Appalachian Power Co.—Biggest private hydroelectric project of the year, 80,000 kw plant on New River at Radford, Va., completed in 1939.

Southern California Edison Co.—Installed two 82,500-kw. units at Boulder Dam in 1939.

Central New York Power Corp.—New plant of 80,000 kw capacity started in 1939 at Oswego, N. Y., and will be completed in 1940. A second unit of 80,000 kw is to be started this year and to be completed in 1941.

Commonwealth Edison Co.—Started another 105,000-kw unit at Powerton (Chicago), to be completed in 1940.

Consolidated Edison Co.—Started 65,000-kw unit at Waterside plant, New York City, to be completed in 1940; another 65,000-kw unit will be added in 1941.

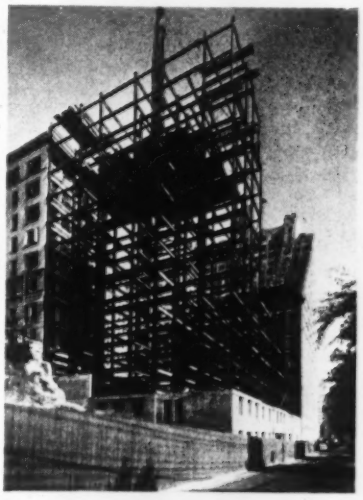
Consumers Power Co.—New 70,000-kw Bryce E. Morrow steam plant at Kalamazoo, Mich., opened November 11, 1939.

Duke Power Co.—Started two 80,000-kw additional units, one at Cliffside, N. C., to be finished this year, the other at Buck steam plant to be completed in 1941.

Indiana and Michigan Electric Co.—The 70,000-kw Twin Branch (Indiana) plant will be finished in 1940.

Ohio Power Co.—Windsor, W. Va., 60,000-kw plant opened in 1939.

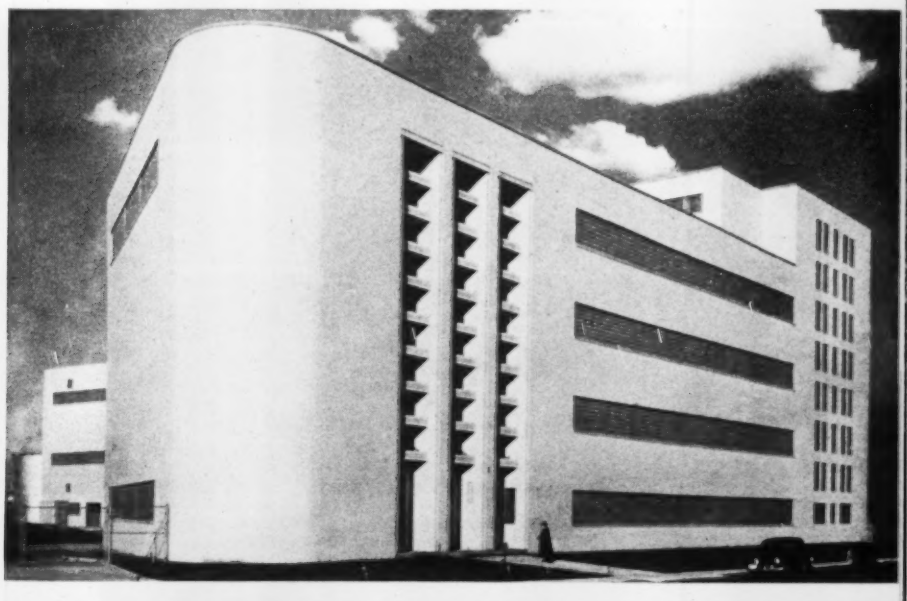
Detroit Edison Co.—Will complete 75,000-kw unit at Conners Creek plant in 1940, another 60,000-kw unit at the same plant will be completed in 1941.



Welded framework rises for Jersey City's Margaret Hague Memorial Hospital.

A 14-story welded addition to Chamber of Commerce Building Project in Houston, one of 1939's busiest building cities.

Air conditioned baking soda plant of Church & Dwight Co., Syracuse, N. Y., is characterized by a striking modern exterior and an arc welded frame that carries unusually heavy loads.



POWER & IRRIGATION

GRAND COULEE DAM—No concrete was poured at Grand Coulee Dam in January or February, 1939, because of cold weather. For the remaining ten months up to December 20, the total concrete placed was 3,638,815 cu. yd. bringing the total as of that date to 9,048,229 cu. yd. Excavation for the pumping plant was completed and the first concrete in the pumping plant wing dam was poured. Rock excavation was completed for the 12 pumping plant discharge tunnels. Thirty draft tubes were installed to serve the left powerhouse, and the concrete powerhouse structure was poured for the nine main units. Considerable penstock work was done in the right powerhouse. Fabrication of penstock sections, up to 1½ in. in thickness and 18 ft. in diameter, has been proceeding steadily near the dam.

BONNEVILLE DAM—The first two 66,000-hp units installed at Bonneville in 1937 are now delivering power to the Portland-Vancouver area over recently completed transmission lines. Four additional units of 74,000 hp each are now under construction; two to be completed about January 1941, and the other two a year later. The power house structure for these four additional units is nearing completion.

BOULDER POWER PLANT—During 1939, two 115,000-hp units (A-6 & A-7) were put into operation making an installed capacity for the plant of 975,000 hp out of an ultimate 1,835,000 hp. Two additional units now being installed are scheduled for operation early in 1941.

PARKER DAM POWER—Work began in 1939 on a Parker Dam power plant to contain three 30,000 kva units, scheduled for completion in 1941. Transmission lines from Parker to Phoenix, Ariz., were completed in 1939 and power lines from Parker to the Gila project will be built in 1940.

RIO GRANDE—The power plant at Elephant Butte dam on the Rio Grande, New Mexico, was under construction with government forces. Three 9,000-kva generators and 11,500-hp. turbines make up the installation. Completion of the Caballo regulating resorvoir, about 25 miles downstream from Elephant Butte, will allow the power plant to operate continuously. The estimated cost of the development, including transmission lines and substations, is $2,390,000.

TRI-COUNTY PROJECT—The Central Nebraska Public Power & Irrigation District has awarded 85 construction and equipment contracts totaling $25,000,000 for work on the Tri-County project, which is estimated to cost $36,000,000. Kingsley Dam, an earthfill 160 ft. high to form a storage reservoir on the North Platte River, is 80 per cent complete, including relocation of 33 miles of Union Pacific R.R. The 75 miles of supply canals are 75 per cent complete and the thr[illegible] houses are 60 per cent compl[illegible] work has been done on the ma[illegible] mission lines and substations. [illegible] gation canals serving an area o[illegible] acres were 83 per cent complet[illegible] the end of the year.

SANTEE-COOPER PROJECT—T[illegible] tee-Cooper power and navigation [illegible] in South Carolina consists of a da[illegible] the Santee River, a diversion ca[illegible] through to the Cooper River wa[illegible], and a dam known as Pinopolis Da[illegible] the Cooper River, at which is a power house and navigation lock. The project is being built by the South Carolina Public Service Authority at an estimated cost of $41,000,000. Most of the work is under contract and earth-moving into the long fills that makes up a large part of the dams is well under way. The placing of concrete has begun in the lock walls and in the foundation of the power house. Difficulties in obtaining land have held up the start of construction on the diversion canal. The work is expected to be completed within the next two years. Equipment for the development of 213,300 hp. will be installed in the power house on the project.

SKAGIT PROJECT—Ross Dam (formerly Ruby Dam) now under construction in the Skagit River gorge about 100 mi. northeast of Seattle is a variable radius arch 290-ft. high on whose crest a 15-ft. temporary timber dam will bring the total height of the first stage to 305 ft. (storage 100,000 acre-ft.). In 1939 excavation was completed (200,000 cu. yd.) and 310,000 cu. yd. of concrete was poured. The central portion of the dam was brought to full height of the first stage and 75 per cent of the high pressure grouting was completed.

Jeffrey power plant, one of three on the supply canal of the Central Nebraska Public Power and Irrigation District. This plant develops a head of 116 ft. in two turbines of 13,000 hp. capacity each.

MISCELLANEOUS

ARROYO SECO PARKWAY—Work progressed steadily on the high-speed motor route from downtown Los Angeles to Pasadena. Channel lining in Arroyo Seco was 85 per cent completed, numerous bridges are under construction, several short sections of the route are already in service and more are to be completed early in 1940. The last link of the $10,000,000 parkway project is to be finished in June 1941.

BANKHEAD TUNNEL—The $4,000,000 vehicular toll tunnel under the Mobile River at Mobile, Ala., is about 50 per cent completed. Work is well along on the placement of the 300-ft. sections of the tube, which are being placed in trenches along the river bed. June 1 is set for completion, but trouble in getting approaches under way is expected to delay opening until Fall. The tunnel section is 2,000 ft. long, providing 21-ft. of roadway from curb to curb, with a walkway for police.

BAYONNE TERMINAL — Bulkheading and dredging for this $4,215,000 project is completed; one transit shed, 1,000 ft. x 140 ft. is finished, as are roadways, two miles of 12-in. water main and one 100,000-gallon water tank. Extension of standard railroad track next to bulkhead will be under construction soon. Operation of the terminal started on March 1, 1939.

BELT PARKWAY, N. Y. C.—Latest and longest of New York City express roads, the 31-mile Belt Parkway, traversing the southern and eastern boundaries of Brooklyn and Queens to a connection with the Whitestone Bridge and The Bronx, was brought near to completion during the year. Present construction involves a four-lane divided roadway and 70 grade separation bridges.

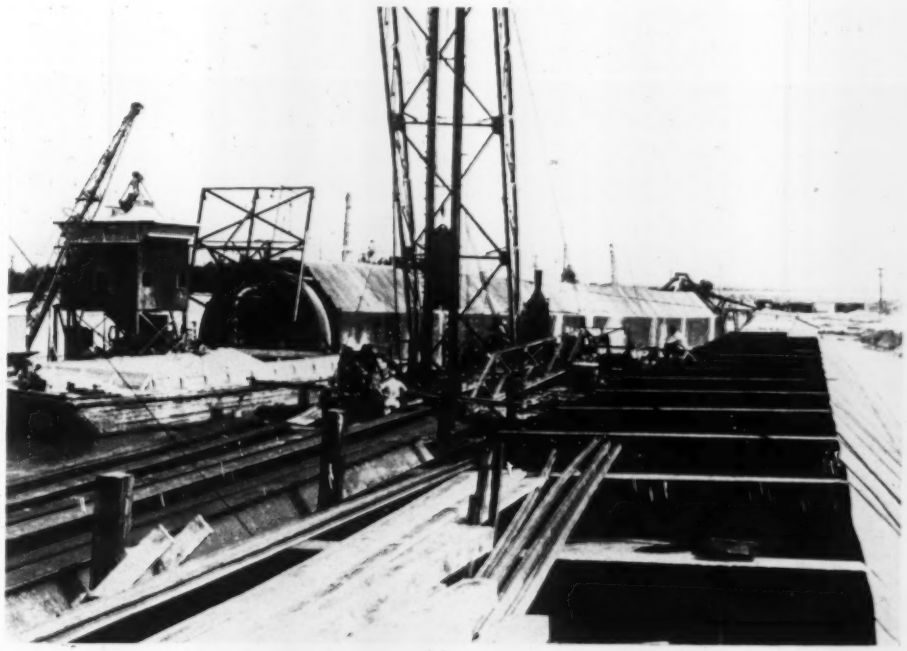
CHICAGO SUBWAYS—During 1939 construction progressed satisfactorily on the first subway for Chicago, a 7.7-mile system of twin tubes. Although ground was not broken until Dec. 17, 1938, contracts amounting to $31,256,856 were awarded and 31,300 ft. of tubes, or 38 per cent of the total, has been completed. The completed portion includes two entire contract sections, one 3,635 ft. long, the other 3,577 ft. long. Tunneling in the downtown area, where the shield method will be used, was started. Construction of stations, the last phase of the work, will begin soon. The project is to be substantially finished by Dec. 31, 1940. The name of the agency handling the subway has been changed from the Department of Subways and Traction to Department of Subways and Superhighways. A comprehensive 32½-mile system of superhighways to cost $110,000,000 is proposed.

DENVER MARKETS—Aug. 1 saw the fast-built million dollar Wazee Produce Market in Denver opened after five months construction period involving demolition of five blocks occupied for a quarter century by junk dealers. Five railroads, Santa Fe, Burlington, Rock Island, C&S and Rio Grande, cooperated in building the Market which comprises four concrete and steel produce buildings. Five months was also the time required to build the Union Pacific's terminal market, which comprises 3 warehouses, garage, three 300-ft. sheds and an administration building.

EAST RIVER DRIVE, N. Y.—Reclamation of the East River shorefront of Manhattan for public use after three centuries of private occupation is moving rapidly toward completion over a 5-mi. line between Montgomery St. and 93rd. St. This riverside improvement comprises bulkheads of solid masonry and of the "relieving platform" type on piles, two 3-lane traffic roadways, a water-edge promenade, parks and up-to-date mercantile maritime facilities. The work is being done by contract at an estimated cost of $14,000,000. Excepting the section from 30th to 49th Sts., now in the plan stage, it is 50 per cent completed.

LINCOLN TUNNEL—The Lincoln traffic tunnel under the Hudson River between New York City and Weehawken, N. J. is now complete except for the finishing of the north tube, which will be deferred until traffic conditions warrant its opening. Last year the extensive approach on the New Jersey side, consisting of a depressed highway through Weehawken and Union City, was completed and connected with the New Jersey state highways on the west side of Union City.

LONG ISLAND GRADE SEPARATIONS—Grade separation work on the Atlantic Ave. and connecting lines of the Long Island Railroad in Brooklyn and Queens, totaling $37,000,000 was begun in October, 1939, and will be completed in 1942. A total of 62 crossings is to be eliminated. Included is the construction of 4.75 miles



Some 300-ft. sections for Bankhead Tunnel being prepared for launching and sinking to position. Ends of the sections are sealed, and the sections are floated to position over a trench in the Mobile River bottom.

North Fork Dam in California was built to catch hydraulic mining debris.

of 2-track subways and the elimination of 1.25 miles of elevated structure.

LOS ANGELES TERMINAL—The Union passenger terminal at Los Angeles, in whose construction the Southern Pacific, Santa Fe and Union Pacific railroads have been cooperating, was put into service May 7, 1939. Its total cost was about $12,400,000. As a separate project, the Southern Pacific completed a new coach yard nearby at a cost of about $700,000.

CALIFORNIA DEBRIS DAMS—Work was under way during 1939 on all four California dams that are to catch hydraulic mining debris. The 155-ft. concrete arch on the north fork of the American River was completed and put in service early in the year. The Narrows Dam on the Yuba River, a 237-ft. arched, gravity section, was started in February 1939 and scheduled for completion in 1940. The Ruck-a-Chucky Dam on the middle fork of the American River, started in September 1939, is to be 148-ft. high. An additional appropriation of $30,000 was obtained for more foundation exploration at the site of the proposed triple arch structure 122-ft. high to be built at Dog Bar on the Bear River.

NEW YORK SUBWAYS—Construction of the Sixth Ave. subway in New York, extending from 8th St. to 53rd St., was substantially complete at the end of the year. Installation of tracks, signals, electrical equipment and escalators was under way. Some of the stations on the line are being finished off. Another contract for the extension of the Fulton St. line of the Independent Subway System in Brooklyn was let last October. The extension is now under construction from Rockaway Ave. to Crystal St.

PENNSYLVANIA TURNPIKE — The Pennsylvania Turnpike, four lane superhighway being built between Harrisburg and Pittsburgh, was about 70 per cent completed at the first of the year. Practically all of the heavy grading had been done, the major structures are nearly finished, and about 20 per cent of the concrete paving has been laid. Rapid progress is being made in driving the seven tunnels, aggregating 6.7 miles in length; at the end of the year they were 57 per cent complete. Part of the tunnel work is enlarging headings driven for the old South Penn Railroad 50 years ago. Concrete lining has been started in three of the tunnels. The last of the paving contracts will be let early this spring and progress to date on all classes of work indicates that the highway will be opened on schedule July 4, 1940, 18 months after it was started.

RICHMOND (VA.) PORT—The municipal development costing $2,250,000 is 65 per cent complete, the remaining item being storage bins. Work undertaken last year included construction of 1,250 linear ft. of concrete wall, dredging 1,325,000 cu. yds. for a turning basin, and the construction of concrete warehouses, railroad and highway facilities. Channel improvements completed by the War Department provide a 25-ft.-deep water way from the mouth of the James River to the terminal.

QUEENS MIDTOWN TUNN tubes of the 7,800-ft. Queens M nel between 42nd St. Manh Queens under the East River in were holed through on Nov. 8, 19 of concrete lining is now und both tunnels. The tunnel ap the Manhattan side and the approach on the Queens side are complete.

WASHINGTON NATIONAL —Construction of a new airport National Capital was begun dur A site of some 742 acres is being on the West side of the Potom opposite the city of Washingto by hydraulic fill involving the pu more than 15,000,000 cu.yd. of material from the river.

SKYLINE DRIVE and Blue Ridge Parkway—Extending from the Shenandoah National Park to the Great Smoky Mountains National Park, this 570-mile route has bituminous surfacing on 245 miles of its length, and stone surfacing on 58 miles more. Grading and stone surfacing is underway on 72 miles, and projects now in prospect will provide for similar work on another 40 miles.

CONNECTICUT PARKWAYS—34 miles of the $21,000,000 Merritt Parkway has been opened to traffic, and the remaining 3.8 miles to the Housatonic River is ready for surfacing. The Wilbur Cross Parkway, from the Housatonic to a point 5½ miles northeast, will be graded in 1940. The Housatonic River bridge is under way.

ROCKEFELLER CENTER—The last rivet on the fourteenth and last building of New York's Rockefeller Center was driven late in 1939 to signalize completion of nearly a decade of work. Major development work on the 12-acre site began in 1931, and more than $100,000,000 has been invested.

NORTH BEACH AIRPORT—La Guardia Airport at North Beach, New York City, was formally dedicated in October. It provides terminal facilities for transcontinental and transatlantic flying service; total cost is $40,000,000.

Warehouses and alongside concrete wharf wall for the Richmond Port Terminal.

EUGENE MASTERS

City Manager, St. Augustine, Florida

writes:

"St. Augustine, Florida, the oldest city in the United States, recently had occasion to open one of the main lines of its water distribution system. While a baby in age as compared to the life records of many cast iron water mains, still a half century of usage left this main in perfect condition, both inside and out. The cost of maintenance of this old cast iron main has been negligible—less than 10 cents per mile per year—there never having been a break of any nature according to our records or the memory of our older employees."

LOW MAINTENANCE

is an economy feature of cast iron pipe that is proved by water works records the nation over. An impartial survey among 195 waterworks superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.

LONG LIFE

To quote Mr. Masters further; "... a half century of usage found this main (*shown at right*) in perfect condition. A 4-inch plug was recently removed for a new tap and this cut revealed that the inside tarred appearance of the main was as clean and perfect as the day it was laid."

SALVAGE VALUE

(*Upper left*) A line of 14-inch cast iron pipe, after 43 years' service in the water distribution system of Kenosha, Wis., was removed and relaid in a new location. Salvage value is one of the major economies of cast iron pipe.

WATER MAINS represent about one-third of this country's 5-billion-dollar investment in public water supply systems. More than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials. Because the tax-saving, through avoiding replacements, is enormous, cast iron pipe is known as Public Tax Saver No. 1.

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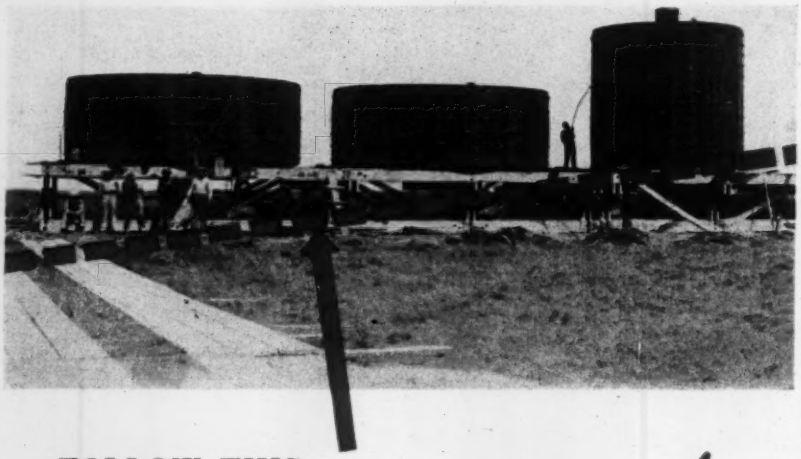
CAST IRON PIPE

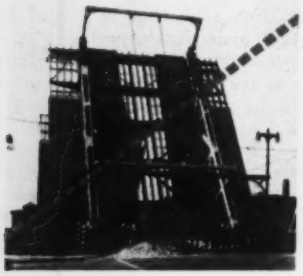
PUBLIC TAX SAVER NO. 1



FOLLOW THIS

Line of Attack

TO CUT COSTS, INCREASE ENDURANCE



Above is a tank substructure in the East Texas oil field, built of prefabricated Wolmanized Lumber—below, the Dearborn Street Bridge, Chicago, reconstructed with a light, lasting deck base of Wolmanized Lumber, which bonds well with asphaltic surfacing.

When you tackle a job which requires enduring construction, within a limited budget, remember Wolmanized Lumber*.

To basic economies of lumber in material cost and handling, it adds continuing economy in permanent structures because it is protected against decay and insect attack.

Wolmanized Lumber is the *only* treated lumber having all four of these important advantages: (1) pressure treatment; (2) cleanliness; (3) protective salts "fibre-fixed" in the wood and highly insoluble; (4) the dependability of a material treated under one standard specification, and sold under one brand, from coast to coast.

Ask for the booklet *"Wood Preservation,"* describing the use of Wolmanized Lumber in many representative applications. AMERICAN LUMBER & TREATING COMPANY, 1435 Old Colony Building, Chicago.

*Registered Trade Mark

WOLMANIZED LUMBER

(News continued from page 57)

MEN AND JOBS

M. C. MAPES, vice-president and treasurer of Westcott & Mapes, Inc., engineers and architects of New Haven, Conn., has been promoted from the grade of major to that of lieutenant-colonel in the Engineering Reserve, U. S. Army, and made executive officer of the 301st Engineers, 76th Division. Following duty in Europe during the World War, Mapes resigned from military service in 1919. In 1924 he accepted the commission of captain in the Engineers-Reserves and was promoted to major in 1931.

HOWARD C. WILLIAMS, acting WPA director for Kansas City, has been named director of the St. Louis district to fill the vacancy caused by the recent death of L. E. GREATHOUSE. Williams was formerly employed in the state headquarters at Jefferson City, Mo.

J. CARLETON WINSLOW has resigned as traveling construction engineer for the Pennsylvania State Highway Department to start a private architectural practice at Indiana, Pa.

RAYMOND L. STEVENSON, acting engineer for Black Hawk County, Iowa, has received a permanent appointment to succeed EDWARD E. HOGELAND.

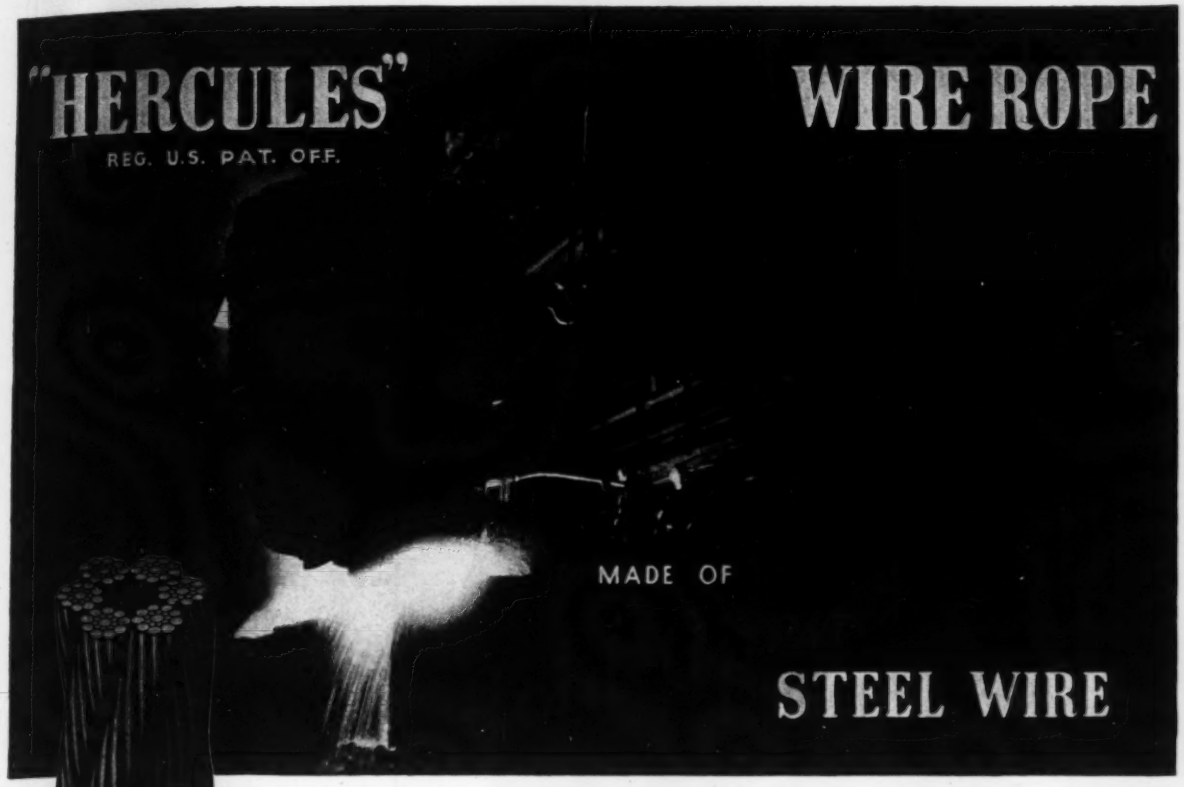
CURTIS DECKER, inspecting engineer for the Bryan, Ohio, sewage disposal system during the past two years, has been made superintendent effective Mar. 15, when the $225,000 project is scheduled for completion. Decker will also serve as city street commissioner.

CARL H. BISCHOFF, graduate of the University of Maine, has resigned his position as civil engineer at Waialua, Territory of Hawaii, because of ill health. He plans to return soon to western United States. JOSEPH MATSON, JR., who has been serving as engineer for Maui since 1937, will succeed Bischoff. A. PAUL LOW, who is now working as project engineer on a Wailuku sewer job and formerly engineer of Maui, will succeed Matson.

REX C. NEWMAN, of Birchurdville, Pa., has been made engineer with the Pennsylvania state Highway Department; AMBROSE R. WEST, of Plymouth, bridge designer; ROBERT J. HILL, of Hazleton, and STANLEY G. ROKOSKI, Wilkes-Barre, construction inspectors. Men who have left the department to take other employment include: HENRY V. PATTERSON, Reading, engineer; ROBERT B. RYDER, Norristown, engineer; HARRY H. MILLER, of Steelton,

"HERCULES" WIRE ROPE

REG. U.S. PAT. OFF.



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Acid open-hearth steel is more uniform in its chemical analysis, freer from slag and impurities, and has a higher elastic limit for the same carbon content than basic open-hearth steel. Most important to the wire rope user, however, is the fact that wire rope made from acid open-hearth steel wire has higher fatigue resisting qualities, which means longer life in actual service.

And our policy of leaving nothing to chance in the manufacture of "HERCULES" (Red-Strand) Wire Rope, not only makes it long lasting, but safe and economical as well.

For maximum efficiency in Preformed Wire Rope, use Preformed "HERCULES". It is available in both Round Strand and Flattened Strand constructions.

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materials engineer; GORDON P. SMITH, of Easton, construction inspector, and JOHN K. MORROW, of Pittsburgh, engineer.

CAMPBELL T. SMITH, civil engineer of St. Catherines, Ont., has been appointed engineer and suburban road engineer for Frontenac County, Ont., with headquarters at Kingston, Ont. Smith replaces J. E. Goodman, who is on leave of absence for military service.

HARRY J. KRUM, Upper Darby, Pa., has been appointed assistant engineer for the Pennsylvania department of health.

JOHN A. BRUHN, business agent, assistant treasurer and a director of the Indianapolis Water Co., has resigned to enter the insurance business. Bruhn, associated with Indianapolis Water for 11 years, was a vice-president of the Indiana section of the American Water Works Association.

JAMES B. BATY, member of the civil engineering staff at Queen's University, Kingston, Ont., has been appointed editor-in-chief of *Water and Sewage*, one of two publications now published as the *Canadian Engineer*, the other being *Roads and Bridges*. Baty, a civil engineering graduate of the Texas A. & M. College, worked for a time as assistant sanitary engineer in the New Jersey State Department of Health.

LESLIE GATES, assistant regional engineer with the Public Works Administration at Omaha, has been scheduled for transfer to the Chicago office.

HORACE L. SEYMOUR, engineer and town planning consultant at Ottawa, Ont., has been employed to make a preliminary planning survey in Soult Ste. Marie, Ont.

T. J. POUNDER, civil engineer and a former resident engineer for the Manitoba highways department and Saskatchewan highways department, has been appointed manager of the asphalt sales department of the British American Oil Co., Ltd., Toronto, Ont.

G. RUSTON has been appointed superintendent of waterworks and electric street lighting at Kenilworth, Ill.

JOHN MCNICHOLL, superintendent of waterworks at Lake Forest, Ill., has been appointed village manager. McNicholl is succeeded by L. G. WATSON, an engineer.

GEORGE A. FLEMING, engineer at the Denver office of the Bureau of Reclamation, has been designated by

Burger Diffuser Plate Holders installed in an unusual, tapered arrangement.

Fire in the air filters caused soot to be forced through all the air lines, finishing what industrial waste in the sewage had started months before. Diffuser plates were so badly clogged that it was found advisable to clear them while the plant was down for repairs. Burger diffuser plate holders greatly simplified the job.

Unscrewing the holding-down bolts permitted the plates to be lifted off. After being cleaned in acid, the plates were again set in place on the holders and made air- and water-tight by bolting them against long-lived rubber gaskets. Aeration tanks were soon ready to go to work again.

Burger diffuser plate holders are equally valuable as labor savers in every-day plant operation. Made of lightweight Alcoa Aluminum, assemblies of as many as eight plates are easily lifted in and out of the tanks. Simple couplings connect them to air lines. There's no rusting to speed clogging of plates.

For further data and prices, write ALUMINUM COMPANY OF AMERICA, 2108 Gulf Bldg., Pittsburgh, Pa.

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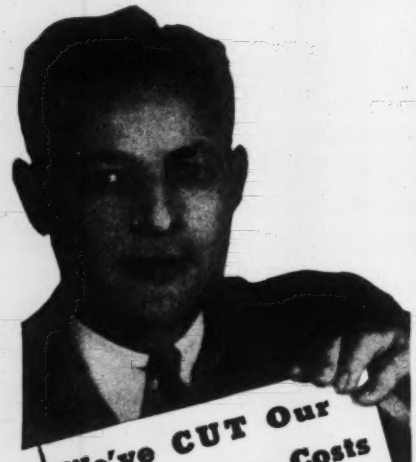

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—results are better,
COSTS FAR LESS"

Use this lightweight, portable compressor expect remarkable results

Think of the saving you'll enjoy with a Smith Compressor, MADE FROM FORD PARTS, that uses only one gallon of gasoline an hour—that is priced at LESS THAN HALF the cost of standard compressors of equal capacity!

Use it for finishing work on slopes, testing and repairing joints in concrete pavements, sub-drainage and sewer work and for a wide variety of general maintenance work. There's ample power to operate rock drills, paving breakers, tampers, sand blasts, rivet hammers, spades, picks, carving tools, metallizing guns, paint guns, etc.

60 cu. ft. a minute capacity; pressure up to 175 lbs. a square inch. Head equipped with high speed compressor valves; automatic unloading and idling.

With a Ford Motor and shop facilities you can assemble your own compressor. We will furnish a Smith Compressor Head and Accessories with instructions for mounting.

GORDON SMITH & CO.
430 College St. Bowling Green, Ky.

Secretary Ickes to aid the Department of the Interior in making a technical review of certain appraisals made by the Utilities Commission of the city and county of San Francisco.

ALSTON DANA, who has been employed for the past 15 years as engineer of design with the Port of New York Authority and the Triborough Bridge Authority, has been employed by the Panama Canal Zone in the special engineering division. Dana was employed on the design of the George Washington, the Triborough, the Bronx-Whitestone, and Bayonne bridges. From 1921 to 1926 he served as assistant engineer of design with the Delaware River Joint Commission. He also taught for two years at the University of Montana, following work at Harvard and Massachusetts Institute of Technology. In his new work, he will act as assistant to E. S. Randolph, designing engineer.

CAPT. L. F. RHODES, district engineer, U. S. Engineers, Louisville, Ky., is in charge of a survey to determine the best site for a dam on the White River upstream from Shoals, Ind. The dam is to be built for flood control work, the cost of the work being estimated at $12,000,000.

ELMER HAGER, Denver engineer, is now affiliated with the Soil Conservation Corps as assistant district engineer of the Colorado area, with offices at Denver. RUSSEL STOKER is chief engineer of the district.

GEORGE MCCORMICK, formerly with the Public Works Administration and located at Fort Worth, Texas, is now serving as construction engineer for the Mead & Mount Construction Co., Denver, Colo., on a project at Lowry Field, Colo.

EUGENE HOWELL, former assistant state sanitary engineer for Colorado, has resigned to take up new duties as assistant public health engineer for the Farm Security Administration for regions 9, 10 and 11, which include the ten western states and Alaska. Howell's headquarters will be at Denver.

ORRIS BONNEY, assistant city engineer of Columbus, Ohio, has been appointed coordinator of the Columbus WPA program, which is to be expanded to employ at least 2000 men.

SAM DALTON, maintenance engineer with the Mississippi State Highway Department, has resigned, effective Apr. 1, 1940. He will be succeeded by A. J. YATES, assistant construction engineer in the central district.

MEETINGS

AMERICAN CONCRETE INSTITUTE Chicago, Ill., Feb. 27-29.

AMERICAN SOCIETY FOR TESTING MATERIALS regional meeting, Hotel Statler, Detroit, Mich., March 4-8.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, March 12-14.

REGIONAL AND LOCAL

SOUTHWEST ROAD SHOW AND SCHOOL, Wichita, Kans., Feb. 20-23.

ONTARIO GOOD ROADS ASSOCIATION, annual meeting, Royal York Hotel, Toronto, Feb. 21-22.

IOWA ENGINEERING SOCIETY, annual convention, Ames, Feb. 29-March 1.

ARKANSAS ENGINEERS CLUB, annual meeting, Hotel Marion, Little Rock, Feb. 23-24.

HIGHWAY ENGINEERS and Commissioners of the Upper Peninsula (Michigan), Houghton, Mich., Feb. 23-24.

ASSOCIATED GENERAL CONTRACTORS, Minnesota Chapter, Minneapolis, March 7-10.

AMERICAN WATER WORKS ASSOCIATION, Southeastern Section, annual convention, Birmingham, Ala. Mar. 18-20.

NEW JERSEY SEWAGE WORKS ASSOCIATION, silver anniversary convention, Trenton, N. J., Mar. 20-22.

NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION, annual meeting, Hotel Haddon Hall, Atlantic City, March 20-22.

AMERICAN WATER WORKS ASSOCIATION, Canadian section, annual convention, March 27-29, London, Ont.

ELECTIONS AND ACTIVITIES

BERTRAM P. THOMAS has been installed as president of the Tacoma, Wash., section of the American Society of Civil Engineers. Other officers are: Fred C. Dunham of Olympia, vice-president; Wells S. Ashby, secretary-treasurer, and Lothrop Crosby, directors.

THE ANNUAL MEETING of the Canadian Construction Association was held in Toronto, Ont., Jan. 16-18. With registration totaling almost 500, all sessions were well attended. Much attention was given to formulating plans for the efficient execution of construction work

(Continued on page 122)

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MARCH 1st . . . the Cummins Engine Company will make an announcement of the most vital interest to every prospective purchaser of a diesel engine . . . an announcement that only the pioneer in diesel development *could* make.

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

CANAL LINING, STRUCTURES CALIFORNIA

OWNER: Bureau of Reclamation, Delta Division, Central Valley Project, California; Walker R. Young, supervising engineer.

PROJECT: Earthwork, canal lining and structures, station 1542 + 72 to station 1993 + 11, Contra Costa Canal, Delta division, Central Valley Project, California. Work is located from about two miles north to four miles south of Concord, Calif.

CONDITIONS: Work to be completed in 450 calendar days. Government to furnish cement, sand, rock or gravel, reinforcing bars, metal plates and coating material, and all other materials to be incorporated in completed structure. Hauling costs for these materials included in unit prices. Wage rates are: skilled, $1.00 to $1.67 per hr.; semi-skilled, 85c. to $1.00; and common labor, 81¼ to 87½c. per hr. Contractor to provide own access roads; and must provide for continuous service of waterlines, etc., that are interfered with during construction.

BIDS: Seven bids were received January 15, 1940, ranging from the contract low of $193,590 to $231,194.

LOW BIDDERS:

1. Heafey-Moore Co. and Fredrickson & Watson Constr. Co., Oakland, Calif. $193,590
2. Calowell Constr. Co., Bakersfield, Calif. 194,469
3. M. J. B. Construction Co., Stockton, Calif. ... 204,934

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear orchards and vineyards	24 ac.	$35.00	$100.00	$100.00
2. Grub orchards and vineyards	22 ac.	50.00	100.00	100.00
3. Excavation for canal	340,000 c. y.	.098	.125	.10
4. Overhaul	250,000 sta. y.	.01	.022	.005
5. Compact embankments	15,000 c. y.	.14	.16	.12
6. Excavation, structures	9,000 c. y.	.65	.40	.90
7. Trim found'n. for conc. lining	113,000 s. y.	.17	.13	.20
8. Backfill	16,000 c. y.	.25	.15	.20
9. Puddle or tamp. backfill	10,000 c. y.	.45	.40	.35
10. Concrete, structures	1,875 c. y.	20.00	20.00	20.00
11. Conc., canal lining	9,300 c. y.	6.25	6.00	6.80
12. Place reinf. bars	830,000 lb.	.017	.016	.017
13. Dry-rock paving	500 s. y.	2.50	2.00	2.50
14. Timber in struct. exc. cattle guards	180 Mbm.	31.00	25.00	35.00
15. Constr. cattle guards	16 ea.	40.00	35.00	60.00
16. 12-in. concrete pipe	100 l. f.	.55	.60	.40
17. 15-in. concrete pipe	300 l. f.	.70	.60	.60
18. 18-in. concrete pipe	280 l. f.	.79	.60	.80
19. 24-in. concrete pipe	410 l. f.	1.00	.60	1.00
20. 30-in. concrete pipe	350 l. f.	1.14	.60	1.00
21. Inst. 18-in. metal pipe	2,500 lb.	.06	.05	.04
22. Inst. gates and gate hoists	16,000 lb.	.06	.05	.05
23. Inst. misc. metalwork	7,000 lb.	.08	.05	.06

DREDGING BARGE CANAL NEW YORK

OWNER: Department of Public Works, State Office Bldg., Albany, N. Y.; T. F. Farrell, chief engineer.

PROJECT: Dredging and excavation of Erie Barge Canal, in accordance with U. S. Contract 28, located at Lock 5, Monelto to north side of Seneca Street in Oswego, N. Y. Consists of deepening channel of canal 2 ft. from present depth of 12 ft.

CONDITIONS: Contractor to furnish all materials and complete work in 650 calendar days. Rail, highway and water transportation facilities available. Wage rates are: skilled, 98c. to $1.34 per hr.; semi-skilled, 75c.; and common labor, 50c. per hr. Large portion of work must be prosecuted during winter months while canal is closed to traffic. Work to be performed during navigation season must be carried on without interference to canal traffic.

BIDS: Six bids were received November 9, 1939, ranging from contract low of $597,801 to $1,067,094.

LOW BIDDERS:

1. Dunbar & Sullivan, Detroit, Mich. (contract) $597,801
2. Great Lakes Dredge & Dock Co., Cleveland, Ohio 658,625
3. Morrison-Knudsen Co., Inc., Boise, Idaho 717,930

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav., other than ledge rock	50,600 c. y.	$0.40	$0.91	$3.70
2. Excavation, ledge rock	138,100 c. y.	4.10	4.35	3.70
3. Drilling line holes	9,870 l. f.	1.15	1.20	2.00

HIGHWAYS AND LANDSCAPING ALABAMA

OWNER: Alabama State Highway Dept., C. J. Sherlock, chief engineer.

PROJECT: Grading, drainage and roadside beautification of 3.873 miles of Florence-Athens Road, Lauderdale County, Ala.

CONDITIONS: Rail and highway transportation facilities available. Work to be completed in 140 working days. Materials to be furnished by contractor. Minimum wages specified are: skilled, $1.00 per hr.; semi-skilled, 50c.; and common, 30c. per hr.

BIDS: Four bids were received November 3, 1939, ranging from the contract low of $57,137 to $64,077.

LOW BIDDERS:

1. A. A. Ballew, Sheffield, Ala. (contract) $57,137
2. Carlton Contr'g. Co., Albany, Ga. 60,412
3. Sullivan, Long & Hagerty, Bessemer, Ala... 62,991

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear and grub, all r.-o.-w	L. S.	$1,000.00	$2,000.00	$800.00
2. Clear and grub, beyond r.-o.-w.	2 ac.	50.00	70.00	100.00
3. Remove structures	L. S.	2,970.00	2,460.00	5,385.00
4. New material, struct.	L. S.	105.00	118.00	1,440.00
5. Remove headwalls	34 ea.	4.00	5.00	3.00
6. Reset fence	13,000 l. f.	.05	.03	.03
7. Common excavation	71,000 c. y.	.28	.30	.30
8. Overhaul on excav.	124,000 sta. y.	.02	.01	.01
9. Class A-ext. conc., culvert	266 c. y.	24.00	36.00	30.00
10. Cl. B conc., headwall	34 c. y.	24.00	36.00	30.00
11. Reinforcing steel	38,780 lb.	.05	.05	.045
12. 15-in. conc. pipe	470 l. f.	1.75	1.50	1.25
13. 18-in. conc. pipe	215 l. f.	1.90	2.00	1.75
14. 18-in. conc. pipe	57 l. f.	2.25*	2.30	2.00
15. 18-in. vit. clay pipe-ext.	258 l. f.	2.25	2.70	2.25
16. 24-in. vit. clay pipe-ext.	189 l. f.	3.30	4.00	3.25
17. Relay pipe	6 l. f.	1.00	1.00	3.00
18. Relay side drain pipe	378 l. f.	1.00	1.00	2.00
19. Reset conc. posts	21 ea.	2.00	2.00	2.00
20. Reset anchors	2 ea.	5.00	10.00	5.00
21. Restring wire rope	470 l. f.	.05	.05	.05
22. Right-of-way markers	98 ea.	2.50	3.00	3.00
23. Reset right-of-way markers	16 ea.	2.00	2.00	2.00
24. Sod ditch checks	4,500 s. y.	.60	.42	.40
25. Loamy topsoil	9,000 c. y.	.50	.48	.60
26. Solid sodding	10,500 s. y.	.45	.30	.30
27. Sprigging	228,000 s. y.	.02	.026	.03
28. White oak, 8-ft. to 10-ft.	53 ea.	6.00	9.00	5.00
29. Willow oak, 8-ft. to 10-ft.	39 ea.	6.00	8.00	5.00
30. Dog wood, 6-ft. to 8-ft.	23 ea.	6.00	7.00	6.00
31. Red bud, 6-ft. to 8-ft.	25 ea.	8.00	4.00	6.00

* Vitrified clay pipe.